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ECOREGION BIOASSESSMENT PILOT PROJECT

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TIMBER/FISH/WILDLIFE ECOREGION BIOASSESSMENT PILOT PROJECT

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ABSTRACT

Biological assessment of benthic macroinvertebrate communities was completed at forested stream reference sites in three ecoregions of Washington State: Puget Lowlands, Columbia Basin, and Cascades. Characteristic chemical and biological patterns were explored through reference sites within each ecoregion. Physical characteristics of the reference sites within an ecoregion were reflective of mid-order stream types and conformed, as closely as possible, to the predefined site selection criteria.

Habitat and biological conditions in each ecoregion were determined by using a modified version of the Environmental Protection Agency's Rapid Bioassessment Protocols (RBP). Habitat condition determined through the qualitative RBP scoring system indicated specific seasons that habitat availability to benthic macroinvertebrate communities was reduced due to changing wetted stream bottom surface areas. Bach region had characteristic natural disturbances that determined timing of habitat instability.

Benthic macroinvertebrate communities and surface water conditions were examined for uniqueness by ecoregions and change by calendar seasons. The benthic macroinvertebrate. information was initially examined by detrended correspondence analysis @CA), and best distinctions among ecoregions occurred during the fall, spring, and summer seasons. Two-way indicator species analysis (TWINSPAN) produced lists of genera that were considered unique to each ecoregion. The functional attributes of these "unique assemblages" were used to relate water quality and physical habitat influences that were thought to shape community patterns. Seasonal taxonomic lists were also constructed for each ecoregion that included macroinvertebrates assumed to appear in streams similar to those used in this project.

Seven RBP biometrics were used to define ecoregion macroinvertebrate conditions. Each of the biometrics was examined individually during each calendar season. Three of the metrics commonly used by benthologists were problematic. The "shredders/total abundance of sample organisms" ratio had consistently low values in each ecoregion during the fall and winter. The "EPT/Chironomidae abundance" ratio was not useful for Cascades ecoregion reference streams because of highly variable results. The "scrapers/collector-filterer abundance" ratio was least useful during winter 1991 in this ecoregion, also.

Surface water information was examined through use of principal components analysis to define parameter relationships among the three ecoregions. Many of the parameters measured in this project revealed close associations between the Columbia Basin and Puget Lowland reference sites. The Cascade streams maintained distinct surface water conditions from the other two regions, probably due to increased streamflows and higher gradients. Biological, chemical, and physical instream information surveyed in this project contrasted the mountain ecoregion streams with the valley/plains ecoregion streams.

INTRODUCTION

Biological Assessment

The past decade has been a prolific period for the introduction of environmental evaluation techniques. These methods are intended to give regulatory agencies a better understanding of the continued impact human society places on natural resources. The United States Environmental Protection Agency (EPA) has produced monitoring program guidance documents for the evaluation of water resources that are both understandable and have widespread distribution (Plafkin *et al.,* 1989). As a result, state agencies responsible for water resource surveys use this guidance to efficiently initiate integrated monitoring programs including chemical, physical, and biological components of aquatic systems. Development of environmental assessment methodology usually serves as a major obstacle for state regulatory agencies in implementing efficient monitoring programs.

Biological assessment, or bioassessment, can be applied at one or more levels within an ecosystem. For instance, monitoring for environmental effects may take place at the microorganism level, where algae and protozoa may be of primary interest (Cairns *et al.,* 1972; Cairns and Pratt, 1986; Cairns *et al.*, 1986). More commonly, bioassessment focuses on benthic macroinvertebrates, which are comprised mostly of aquatic insects. Current protocol in analysis of benthic communities examines both the structural and functional attributes (Klemm *et al.,* 1990). The structural features of a benthic community are abundance-based and so deal with the relative abundance of organisms present at a particular site. Functional attributes of a community are defined by the "feeding" mechanisms exhibited by the various taxa (Cummins, 1973; Cummins, 1974; Cummins and Klug, 1979). The same community analysis strategies are also applied to fish assemblages (Karr *et* al., 1986; Miller et *al.,* 1988). These biological analyses help integrate monitoring information and aid state and federal agencies in designing their programs.

Integration of Monitoring Strategies

Physical and chemical water quality parameters are commonly used as surrogate criteria for beneficial uses of fresh and marine waters. Beneficial uses include water supply, recreation, and support of aquatic life. However, physical and chemical analyses should be integrated with direct biological assessment of stream communities for more complete resource evaluation. The integration of biological information with other analyses enhances water resource evaluation by: 1) validating water quality conditions indicated by physical and chemical analyses and criteria; 2) determining expected biological conditions in an aquatic environment; and 3) detecting the presence of intermittent toxic discharges or other limiting factors that may not be identified by periodic water quality monitoring. Incorporation of biological assessment into surface water evaluations further supports the water resource decision-making process by better estimating attainment of designated uses (Ohio EPA, 1990).

Existing State Programs

A number of states have developed and implemented integrated water quality and biological assessment programs. An impetus in developing an integrated monitoring strategy has resulted from the EPA's expectation that all states implement both narrative and numeric biocriteria within the next decade.

The Ohio EPA has pioneered a methodology for establishing effective biocriteria. Biosurveys have been conducted at more than 3,000 sites in Ohio since the late 1970's (Ohio EPA, 1990). These surveys include chemical and physical water quality measurements, fish and benthic macroinvertebrate collections, and physical habitat assessment. Ohio EPA has also implemented numerical biological criteria for both fish and macroinvertebrate assemblages for each of its five ecoregions.

The Maine Department of Environmental Protection has instituted a biological 'assessment program to support the aquatic life standards outlined in their Water Quality Classification Law (Courtemanch et al., 1989; Davies, 1987). The Maine sampling strategy has focused on benthic macroinvertebrate communities upstream and downstream of significant dischargers. Impacted stream reaches were sampled in order to define the most degraded biological conditions. The integrated biological information was then used to implement and evaluate Maine's water quality management policy.

The North Carolina Division of Environmental Management has used a standardized qualitative benthic macroinvertebrate sampling approach for wadeable streams (Lenat, 1983). They have used a variety of biological metrics to determine the condition of water resources. Narrative biocriteria were developed for three ecoregions using total taxa richness and EPT taxa richness (EPT=Ephemeroptera, Plecoptera, Trichoptera) Good correlation between these biometrics and the Water Quality Index (WQI) on individual streams demonstrated that biological assessment was a useful indicator of changes in surface water conditions.

The Arkansas Department of Pollution Control and Ecology has used a modified version of the EPA Rapid Bioassessment Protocols for the past few years (Kathman and Brinkhurst, 1991; Shackleford, 1988). Their primary emphasis has been placed on streams possessing **high** resource value and reaches with the potential for water quality problems. Much information has been gathered from permitted point source dischargers where an upstream/downstream sampling strategy was implemented. Narrative biological criteria have been proposed for the six ecoregions of Arkansas.

Review of Federal Agency Guidance

The concept of biological assessment has also been embraced by federal agencies, which acknowledge its sensitivity in evaluating nonpoint source impacts on water resources. The United States Forest Service Intermountain Region developed a macroinvertebrate Biotic Condition Index (BCI) as a component of their General Aquatic Wildlife System. The BCI correlates taxon presence with a limited number of chemical and physical parameters (Winget and Mangum, 1979).

The United States Fish and Wildlife Service (USFWS) produced a guide for resource managers to evaluate water quality impacts through indicator aquatic organisms (Krueger et al., 1988). The concept of an indicator organism encounters logical problems when applied within an ecological framework. The document does not discuss methodology for collection of macroinvertebrates, but does examine biometrics associated with analysis of each biological group (bacteria, algae, protozoans, macroinvertebrates, fish).

A Water Quality Indicators Guide has been compiled by the United States Department of Agriculture for use by Soil Conservation Service field personnel, particularly district conservationists (Terrell and Perfetti, 1989). The guidance relies on qualitative observations that are more effectively applied with increased evaluator experience. The qualitative evaluation is integrated with an existing water quality monitoring program. Biological groups used for this evaluation scheme include benthic macroinvertebrates, fish, algae, and aquatic plants.

The United States Environmental Protection Agency has developed a plan to monitor the status and trends of ecological conditions through the Environmental Monitoring and Assessment Program (EMAP) (Hunsaker and Carpenter, 1990). This federal program is aimed at confirming the maintenance and improvement of the nation's ecological resources. A similar plan implemented by the United States Geological Survey is the National Water Quality Assessment Program (NAWQA). The objectives for NAWQA projects are to provide consistent descriptions of the nation's water resources, define long-term water quality trends, and to determine major factors that affect water quality conditions and trends (Hirsch et al., 1988).

Regional Stream Biological Assessment Approach

A number of monitoring methods have been developed to help identify attainable biological conditions in streams. Prior approaches have included sampling strategies confuted by watershed boundaries or upstream/downstream and before/after study designs. Intensive investigations of biological impact are well suited for a site-specific monitoring approach, but information gamed by this work is generally not applicable to other areas. A regional approach to biological assessment allows one to more broadly define community reference conditions. Regional biological assessment has applicability to: identification of natural ecological trends; provision of a reference condition for comparison to impacted sites; detection of obscured nonpoint source pollution impact; and development of reasonable chemical and biological standards (Omemik and Griffith, 1991).

Regional monitoring for the purpose of managing environmental resources is potentially an effective approach. Developing regional expectations for physical, chemical, and biological attributes is both time- and cost-efficient for the resources expended. The effectiveness of such a program relies on the ability to locate reference sites that are representative of the water resource being evaluated (Hughes *et al.*, 1986). A collection of reference sites within a region defines a range of physical, chemical, and biological characteristics to which streams suspected of being disturbed may be compared (Hughes and Larsen, 1988). The reference condition is not reflective of the ecological potential of all streams within a region. Unique conditions may occur on a site-specific basis, such as natural springs that sustain stream discharge, barriers to migration, and proximity to large waterbodies.

Regional management of water resources for the protection of beneficial uses has been approached by defining the inherent natural variability of environmental parameters. Biological assessment in Ohio streams has included analysis of fish assemblages as well as the benthic macroinvertebrate assemblages (Karr, 1981; Larsen et al., 1986; Whittier *et* al., 1987). Data sets that were partitioned using regional geographic characterization, defined macroinvertebrate assemblage patterns. Assemblage descriptors such as number of taxa or species diversity showed unique distribution measures on a regional basis. The same regional patterns existed for surface water quality parameters (Larsen *et* al., 1988). Analytical methods such as multivariate analysis and biotic index scores have been applied in identifying distinct regional conditions. Ordination of fish, benthic macroinvertebrate, and periphyton assemblages have been used to define spatial patterns in Oregon stream ecosystems (Hughes *et* al., 1987; Whittier et al., 1988). Other examples of regional biological, chemical, and physical survey approaches include those from Arkansas, Minnesota, Wisconsin, and Nebraska (Rohm et al., 1987; Heiskary, 1989; Lyons, 1989; Bazata, 1991).

Regions that may be used in defining water resource conditions should exhibit continuities in a number of physical, chemical, and biological attributes. Ideally, intra-regional variation should be less than inter-regional variation to permit effective delineation of spatial management units. Gallant *et al.* (1989) describe how regional delineation is used in determining physical, chemical, and biological similarities. The most effective regional strategy employed to date has been the ecological region or "ecoregion" delineation (Omemik, 198'7). Omemik's ecoregions are defined by mappable quantitative characteristics including: land surface form, soil type, land use, and potential natural vegetation. These four characters have been used to define a national ecoregional map at a scale of 1:7,500,000 as well as a northwest regional map at a scale of 1:2,500,000 (Omemik and Gallant, 1986).

Objectives of the Ecoregion Bioassessment Pilot Project

An ecoregion bioassessment project was initiated in Washington to evaluate the usefulness of a monitoring protocol to detect water resource impacts due to forest practices. The Timber/Fish/Wildlife Program (T/F/W) funded Phase I of the project, which concentrated on defining a reference condition for three ecoregions in the state: Puget Lowlands, Cascades, and Columbia Basin. The planned second phase of this project will address streams that experience a gradient of forest practice impacts. Specific objectives for this pilot project included: 1) provision of complete data sets for surface water quality, benthic macroinvertebrates, and habitat in each ecoregion; 2) definition of reference conditions for water quality, macroinvertebrates, and habitat on a seasonal basis; and 3) description of a sampling and data analysis protocol for defining ecoregion reference conditions.

MATERIALS AND METHODS

Site Selection Criteria

Reference site selection in each ecoregion was based on historical physical habitat information and professional judgement of regional biologists. Existing physical habitat information was obtained from ongoing stream surveys of the United States Forest Service (USFS, 1990); United States Geological Survey (USGS, 1991), and the Timber/Fish/Wildlife Ambient Monitoring Program (T/F/W-AMP) (Cupp, 1989; Ralph, 1990; Ralph *et* al., 1991). Regional biologists representing the United States Forest Service, ‘Washington State Department of Wildlife, and Washington State Department of Fisheries were surveyed for suggestions of reference stream locations within their respective management jurisdictions.

Candidate and Final Site Selection

A list of “candidate” reference sites was compiled using existing quantified habitat information in addition to informed suggestions of the regional biologists surveyed. The criteria used for identifying potential candidate sites were:

1. availability of current or historical habitat information to expedite the screening process;
2. the drainage was mostly contained within a single ecoregion;
3. reference site condition was as completely undisturbed by typical regional land use activities;
4. potential site locations were situated on mid-order streams where forest practice activities elicit some of the greatest impacts (an exception to this rule were Puget Lowland streams); and
5. year-round accessibility.

Final reference site selection in each of the ecoregions focused on more detailed aspects of candidate streams, including elevation, gradient, substrate size, discharge, and broad spatial site locations within an ecoregion. Our ultimate goal was to select habitat conditions that were most representative of each ecoregion. Reference site locations i:n this project are displayed in Figure 1. A total of six stream reaches were identified in each of three ecoregions. The six sites were used as replicates to define baseline ecological reference conditions. On-site surveys were completed for final identification of reference stations before monitoring began.

Habitat Structure Survey

Reference stream reaches were 100 meters in length. Reference site location considered physical habitat characteristics that typified streams within each ecoregion. The reference stream reaches

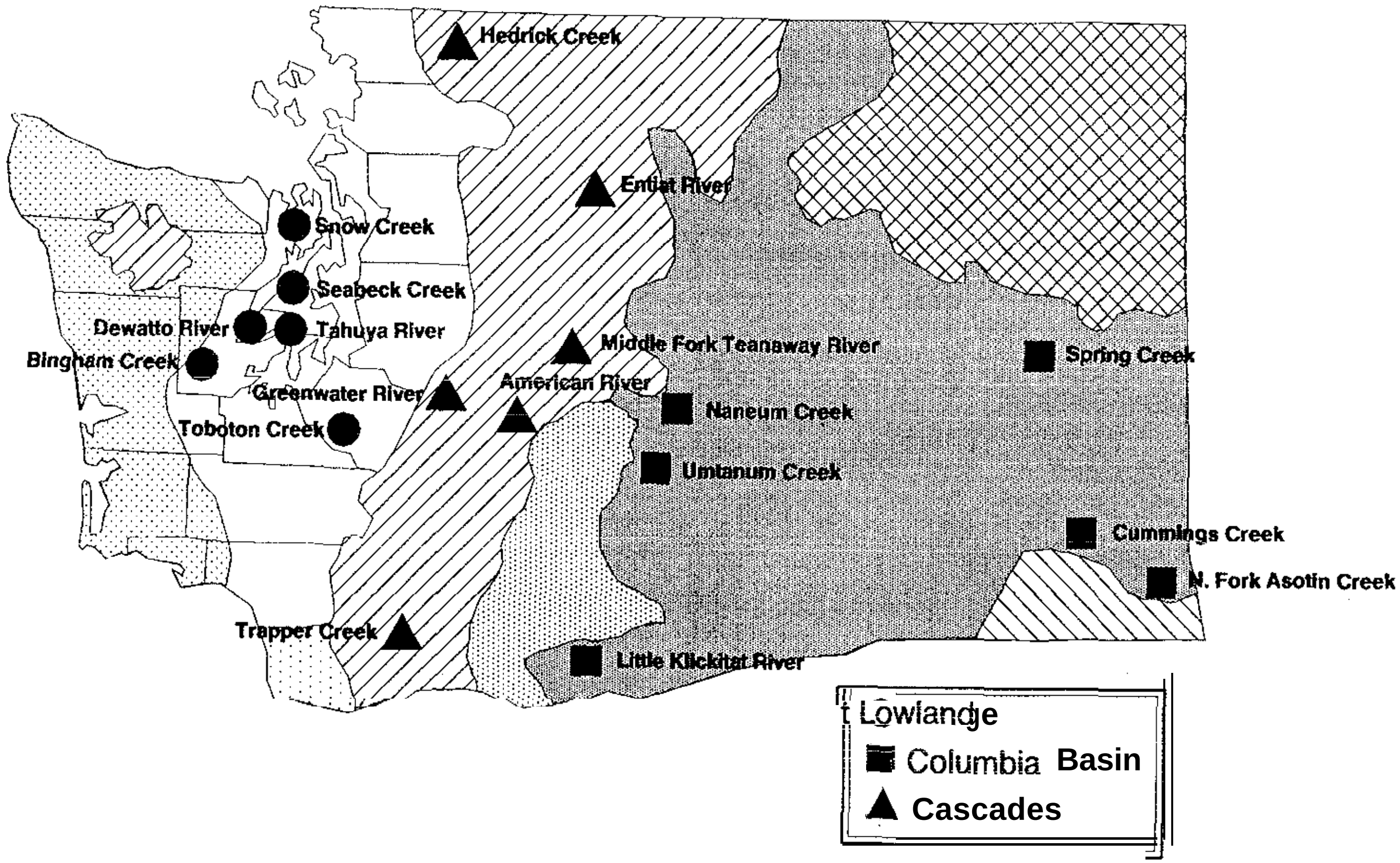

Figure i. Location and identification of sites surveyed in the Ecoregion Bioassessment Pilot Project.

within each ecoregion were typified by a heterogeneous set of habitat characters. These physical habitat characters were reflective of natural stream conditions expected in the ecoregion.

The qualitative habitat evaluation used in this project was that described in the Rapid Bioassessment Protocols (Plafkin *et* al., 1989). The habitat survey was comprised of three major components: primary parameters (substrate and instream cover), secondary parameters (channel morphology), and tertiary parameters (riparian and bank structure). Nine habitat parameters were scored on a numerical scale based on poor, fair, good, and excellent categories. A qualitative habitat assessment is limited to detecting substantial alterations from expected conditions.

The habitat survey form used by the evaluator was duplicated from the Rapid Bioassessment Protocols Document (Plafkin *et* al., 1989) and is provided in Appendix A. Two evaluators participated in habitat assessment at each stream reach. Habitat assessment was completed from November 1990 to August 1991. Future use of qualitative habitat assessment will be guided by a scoring form reflective of Pacific Northwest stream conditions (Hayslip and Montgomery, 1992).

Habitat Analysis

Habitat information for this pilot project was summarized using notched box plots. The purpose for examining habitat score distributions was to provide a measure of habitat score expectations for each ecoregion. Notched box plots were used to display habitat score information on an ecoregion-by-season basis (SYSTAT, 1990). Habitat scores were then partitioned into primary, secondary, and tertiary components for further analysis of habitat-limiting regional features.

Benthic **Macroinvertebrate Monitoring**

Benthic macroinvertebrates were collected during four consecutive seasons from fall 1990 to summer 1991. Sampling was completed at the midpoint of each season (i.e. fall=November 1990, winter=February 1991, spring=May 1991, summer=August 1991). Seasonal reference sampling for invertebrates was essential in accounting for life cycle stage progression, identifying the influence of natural seasonal disturbance frequencies, and for direct comparison to other project samples collected during the same season. Months included within each season were as follows: fall (October-December), winter (January-March), spring (April-June), and summer (July-September).

Field Samoline Equipment

Macroinvertebrate sampling methodology was adopted from the U.S. EPA's Rapid Bioassessment Protocols (Plafkin *et* al., 1989). A 1 square meter kick net was used. The kick net was constructed of nylon screen mesh with 500 micron openings. Two one-inch wooden dowels were attached at opposite sides of the net with plastic tie-downs strung through grommets spaced at eight inch intervals along each side. A weighted cord was placed along the bottom edge of the kick net to prevent organisms from passing under the net. ‘An important aspect regarding net mesh size of the sampling apparatus is that it is a major determinant of collection abundances (Storey *et* al., 1991; Minshall, pers. comm., 1992).

Site Sampling Methodology

Duplicate invertebrate samples were collected from each reference stream reach. Two transects were randomly located within each 100-meter reference reach. Two random numbers were generated with a hand-held calculator (Hewlett-Packard HP-32S). Each transect within the reach was then sampled by compositing material collected within the square meter kick net from the closest riffle and closest run either upstream or downstream of the transect location. A “riffle” was identified by broken surface water and a "run" was identified by unbroken continuously moving surface water. Thus the total area sampled at each transect from a stream reference site was 2 square meters. Composite samples were first collected from downstream portions of a reach, working in an upstream direction. Streams that are not dominated by riffles will present greater difficulty when locating the sampler under this project’s guidelines. It is suggested for future studies that the investigator examine stream characteristics of a region and consider a multihabitat sampling approach. Duplicate samples were collected in order to eliminate investigator bias through stream sampler placement, and also to maximize the likelihood of collecting the greatest variety of taxa.

Sub-Sampling Methodology

Each 2 square meter benthos sample was emptied into a 24cm x 36cm sub-sampling tray gridded with 6cm x 6cm squares. The benthic material was then evenly spread over the bottom and benthic macroinvertebrates were sub-sampled by randomly selecting grid squares. All invertebrates were removed from one square at a. time until at least one hundred organisms were collected. A minimum of two squares in the sub-sampling tray were picked using a lighted hand-held magnifying glass (magnification=5X). Organisms were placed into 250 mL Nalgene® jars with screw top lids. Field preservative was 10% formalin diluted from a stock solution of 37% formaldehyde. When field conditions were unsuitable fo:r sub-sampling (i.e., heavy rain, snow, high winds), kick net samples were placed in double Ziploc® freezer bags. Formalin preservative was added to the inner freezer bag containing the sample and a label with site, collection date, transect number, and preservative was placed in the dry space between the first and second freezer bag. These benthic collections were sub-sampled at a later date in the laboratory using the same procedure. The formalin preservative was replaced with 70% ethanol for subsequent laboratory sorting and identification. Attention was given to the Chironomidae (midges) and Elmidae (riffle beetles) when picking insects in the laboratory. Taxa representing these families tend to be easier to find in live samples.

Laboratory Equipment and Samole Processing

Sorting and identification of the benthic macroinvertebrate samples were completed in the laboratory with a Unitron® Dissecting Stereoscope (magnification range: 7X-45X). Taxa were identified to genus and sometimes species, where reasonably possible. An exception to generic taxonomic identification were the Chironomidae, Simuliidae, Lumbriculidae, Naididae, families of Coleoptera, Planariidae, and Hydracarina. The primary taxonomic keys used were Merritt and Cummins (1984), Pennak (1978), and Wiggins (1977). Additional taxonomic keys that were found useful in this project are listed in Appendix B. A comprehensive literature review for aquatic macroinvertebrate taxonomic keys can be found in Clark (1991).

Benthic Macroinvertebrate Data Analysis

Ordination: Detrended Correspondence Analvsis and TWINSPAN

The benthic macroinvertebrate data set was analyzed using exploratory statistical techniques. Detrended Correspondence Analysis @CA) and TWINSPAN (Two Way Indicator Species Analysis) were used for data sets comprised of counts of individuals (Hill, 1979a; Hill, 1979b; James and McCulloch, 1990). DCA and TWINSPAN analyses (Hill, 1979) are components of the Cornell Ecology Programs (CEP) (Mohler, 1987). A $\log_{10}(x+1)$ transformation was used because of the difference in magnitude between some taxa abundances (Zar, 1984). Otherwise, the ordination analyses used with the macroinvertebrate datasets would have weighted the more abundant taxa in favor of the rarer taxa (Gauch, 1982).

Bcoregion differentiation by season was examined from DCA results. The purpose was to determine uniqueness of community assemblages within the three ecoregions examined and to identify optimal biological sampling seasons for each ecoregion. TWINSPAN was used to determine site associations within each season and to identify distinct taxa associations. These taxa associations were further examined for relationships to other ecosystem components such as habitat and surface water characteristics. Consistent associations between taxa and environmental variables helped define “indicator assemblages”.

Rapid Bioassessment Protocol Analysis

Rapid Bioassessment Protocol (RBP) metrics were calculated based on macroinvertebrate datasets identified to both the familial and generic taxonomic levels (Plafkin *et* al., 1989). The purpose for comparison of metric information derived from family level and generic level identification was to evaluate the most time-efficient and cost-effective approach in applying the RBP’s. A list of the biological metrics evaluated in this project is provided in Appendix C.

The distribution of values for each metric was described by notched box plots produced with the SYGRAPH® software statistical package (SYSTAT, 1990). The purpose for the ‘notched” boxplot was to detect significantly different median metric conditions at the 95% confidence level within particular sampling seasons.

Surface Water Monitoring

Physical and chemical surface water parameters were also characterized monthly in each ecoregion between November 1990 and August 1991. Water samples were collected at the downstream boundary of the 100 meter reference reach prior to collecting the macroinvertebrate samples. Table 1 describes the surface water parameters measured and methods of analysis. Water samples collected each day were shipped within 24 hours to Ecology's Manchester Environmental Laboratory.

Ecoregional Surface Water Patterns

Physical and chemical variables from surface water analysis were analyzed using Principal Components Analysis (PCA). PCA uses multiple variable data sets in constructing a multiple axis cloud of data points. The number of axes corresponds to the number of variables. The first component is a line through the cloud of points that represents the longest distance. PCA 1 now represents variance among the water quality variables and defines variable groups that may be associated with regional conditions. All variable observations are located somewhere along this line and explain contribution of each variable to total variance. The parameters used in this ordination analysis were not measured on the same scale (unit and magnitude differences) and thus were analyzed by using the correlation matrix (James and McCulloch, 1990). Interpretation of surface water parameter associations through ordination are made on the assumption that natural linear or near-linear relationships exist among some variables (Ludwig and Reynolds, 1988). Principal components analysis is useful when the objectives are in data reduction and interpretation (Johnson and Wichern, 1988).

Quality Control/Quality Assurance Procedures

Habitat Assessment

Qualitative habitat scoring was replicated by two evaluators at each reference station on a seasonal basis. Individual differences in the cumulative habitat scores were presumed to result from evaluator unfamiliarity with regional physical characteristics, evaluator experience, and individual habitat metrics that are not amenable to qualitative evaluation. Scores were compared between investigators and justifications for scoring decisions were discussed in order to make the scoring exercise consistent between evaluators.

Benthic Macroinvertebrate Assessment

Duplicate macroinvertebrate samples were collected from similar combinations of habitat types (riffle and run) at each reference station. The location of multiple reference stations within each ecoregion satisfied statistical requirements for sample independence, which was necessary to address the multivariate normal assumption associated with ordination analysis (Johnson and Wichem, 1988). Lack of independent sampling with adequate reference station replication may result in weak inferences of an ecoregion effect (Hurlbert, 1984).

Table 1. Parameters, analysis methods, and. detection limits of water quality data evaluated for the Ecoregion Bioassessment Pilot Project.

Parameter	Method	Detection Limits
Temperature	Mercury-Filled Thermometer	± 0.1” Centigrade *
pH	Beckman pH Instrument	± 0.2 pH units *
Conductivity	YSI Conductivity Meter, Null Indicator	± 2.5 µmhos/cm at 25°C *
Dissolved Oxygen	YSI Membrane Electrode, Model 57	± 0.2 mg/L *
Discharge	Swoffer Flow Meter	± 20 percent of total *
Turbidity	Nephelometric	1 NTU
Alkalinity	Titrimetric	1 mg/L as $CaCO_3$
Hardness	EDTA Titrimetric	1 mg/L as Mg+Ca
Total Organic Carbon	Dohrman TOC Analyzer	0.1 mg/L
Ammonia-Nitrogen	Automated Phenate Method	0.01 mg/L
Nitrate+Nitrite-Nitrogen	Colorimetric, Automated, Cadmium Reduction	0.01 mg/L
Total Phosphorus	Colorimetric, Automated, Ascorbic Acid	0.01 mg/L
Ortho-Phosphate	Colorimetric, Automated, Ascorbic Acid	0.01 mg/L
Total Persulfate Nitrogen	Digestion Technique, EPA Method 353.2	0.02 - 0.2 mg/L

* Field parameter, value reflects instrument error rather than detection limit.

Analytical methods outlined by EPA (1983) and APHA (1989).

Precision of replicate macroinvertebrate sampling was determined at each reference reach by calculating the coefficients of variation (equivalent to the % relative standard deviation) for taxa richness in fall 1990 and spring 1991 samples. Individual reference reach coefficients of variation were partitioned by ecoregion and the root mean square of these were calculated. Distribution of the individual coefficients of variation within an ecoregion indicate the necessity for: 1) increased replication of macroinvertebrate samples at a site, or 2) reduction of sampling effort to fewer samples per site. The root mean square of the ecoregion coefficients of variation describes the expectation of ecoregional replicability between stream sites of similar physical condition (i.e. reference sites).

Surface Water Quality Assessment

Replication of surface water samples was achieved through independent sampling of different streams within the same ecoregion. Duplicate samples were collected from one station in each of two ecoregions every month in order to achieve ten percent replication overall. Stations were randomly chosen for duplicate sampling within the two ecoregions; also, the two ecoregions were never the same on consecutive months.

Field instruments were used to take *in situ* measurements for temperature, pH, dissolved *oxygen*, and conductivity. Calibration of the pH meter (Orion, Model 250A) was carried out at each site before water samples were collected. The dissolved oxygen probe (YSI, Model 57) was calibrated daily and at each station before use. Dissolved oxygen readings were taken from the sample container following collection. The conductivity meter (Beckman Solu Bridge, Model RB5) was calibrated at a frequency of once per month. Sample blanks of deionized water were also analyzed periodically with reference station sample sets in order to detect the presence of cross-contamination.

RESULTS

Physical Description of Reference Sites

Reference site descriptions were based on the "final site selection" criteria. A compilation of elevation information for each sample reach is provided in Table 2. Sample reaches in the Puget Lowlands ranged from 120-650 feet in elevation. Cascade reach elevations ranged from 1,000-2,950 feet. Columbia Basin reference sites were located within the elevation range of 1,600-2,600 feet.

Upstream drainage area was also calculated for each reference site in all three ecoregions (Table 2). Hughes and Omemik (1983) discussed alternatives for characterizing stream size and concluded that watershed area and mean annual discharge per unit area relayed a more accurate representation of stream size. The ratio of mean annual discharge per watershed area provides a standard by which hydrologic watershed characteristics :may be compared. upstream

Table 2. Physica.! characteristics of the basin area upstream of the reference sites.

Site Identification:		Basin Descriptors: Elevations (ft. above mean sea level)		upstream Drainage Basin	Reference Reach Locations: Latitude			Longitude				Legal Description		
Ecoregion	Station	Basin Maximum	Sample Reach	Area (sq.mi.)	Deg	Min	Sec	Deg	Min	Sec	Township	Range	Sec.	Sub-sec.
2	Bingham	2600	650	4.6	47	16	36	123	20	36	T21N	R5W	29	S2
2	Snow	4250	300	11.4	47	56	25	122	53	13	T28N	R2W	11	NE4
2	Seabeck	540	120	2.2	47	37	15	122	50	17	T25N	R1W	31	NE4
2	Dewatio	400	180	5.44	47	31	20	122	57	38	T23N	R2W	5	N2
2	Tahuya	1600	400	8.03	47	31	3	122	52	44	T23N	R2W	1	NW4
2	Toboton	800	460	2.2	46	50	17	122	29	9	T16N	R2E	25	SET.4
4	Hedrick	4900	1000	1.98	48	53	41	121	58	9	T39N	R6E	1	
4	Greenwater	4900	2300	52.1	47	7	26	121	31	57	T19N	R10E	21	NE4
4	American	6500	2950	79.1	46	58	38	121	10	4	T17N	R13E	12	
4	Entiat	6500	1950	158	47	54	12	120	28	22	T28N	R19E	29	N2
4	Trapper	3900	1800	6.9	45	53	44	122	0	55	T5N	R6E	23	SE4
4	MFTeanaway	5900	2600	26	47	17	43	120	57	34	T21N	R15E	21	
10	Naneum	5900	2600	66.8	47	8	21	120	28	19	T19N	R19E	16	W2
10	Umtanum	3900	1600	52	46	36	19	120	29	19	T16N	R19E	19	SE4
10	LKlickitat	4600	1800	78	45	51	5	120	47	1	T5N	R16E	10	NE4
10	Cummings	4900	2300	19	46	34	55	117.	39	14	T10N	R41E	22	
10	NFAsotin	4900	2400	42	46	14	32	117	19	12	T9N	R44E	23	
10	Spring	2800	1600	18	47	45	22	117	53	16	T26N	R39E	16	NE4

2 = Puget Lowland Ecoregion

4 = Cascades Ecoregion

10 = Columbia Basin Ecoregion

watershed area and the discharge regime of a reference site are variables that can be used to relate similar streams within an ecoregion. Table 3 summarizes the water yield per unit area for each reference site. Water yields were higher in the Puget Lowland and Cascade streams. Streams with larger watershed areas generally yielded smaller quantities of water to surface flow probably due to the variety of associated hydrologic processes. Surveys of mid-order streams in this project were chosen based on a hypothesis that greatest macroinvertebrate taxonomic richness exists in these reaches (Vannote *et* al., 1980; Minshall *et* al., 1985).

Substrate size in reference reaches of the Puget Lowland were predominantly cobble, gravel, and sand. The Cascade substrates were cobble, pebble, and boulder, with intermittent gravel dispersion at some sites. Columbia Basin substrates were primarily cobble and gravel. The aforementioned substrate categories are based on the Wentworth Substrate Particle Size Classification (Cummins, 1962). Detailed descriptions of substrate size at reference sites are contained in Appendix D.

Stream gradient was measured previously by surveyors participating in the T/F/W-AMP at sites in the vicinity of each reference reach. Continuity in stream gradient was maintained among the replicate sites within each ecoregion. Discharge rates measured at each reference site are presented in Appendix F, and a summary plot of results is shown in Appendix J15. Discharge in the Cascades ecoregion was considerably higher than in the Puget Lowland and Columbia Basin ecoregions.

Seasonal Habitat Scores

Seasonal habitat scores were summarized using notched box plots. The box plots provided distributional information for the qualitative habitat condition within each ecoregion and examined changes that occurred seasonally (Figure 2). The notched boxplot diagrams exhibit some folding; meaning that the 95 % confidence interval about the median lies beyond either the 25th or 75th interquartile interval. The highest habitat score possible using the Rapid Bioassessment Protocol survey form was 135 points. Seasonal partitioning of habitat scores within the Puget Lowland ecoregion showed very similar median values (Figure 3). The Cascades ecoregion had larger seasonal differences in total habitat scores (Figure 3). Significant median differences existed between fall 1990 and winter 1991 habitat conditions ($p=0.05$). The Columbia Basin possessed the greatest habitat score differences between successive seasons (Figure 3).

As mentioned earlier, the habitat assessment method used in the U.S. EPA Rapid Bioassessment Protocols is based on categories defined by: I.) primary parameters (substrate and instream cover); 2) secondary parameters (channel morphology); and 3) ternary parameters (riparian and bank structures). The potential cause of the differences in habitat scores between seasons was explored by examining these habitat score components.

Table 3. Water yield per unit basin area estimated from watershed area above the reference site location.

Reference Stream	Mean Annual Discharge (cfs)	Basin Area (mi^2)	Water Yield/ Basin Area (cf/mi^2)
Puget Lowland			
Bingham Creek	21.23	4.6	4.62
Snow Creek	18.86	11.4	1.65
Seabeck Creek	8.36	2.2	3.8
Dewatto River	15.49	5.44	2.85
Tahuya River	32.02	8.03	3.99
Toboton Creek	6.11	2.2	2.78
Cascades			
Hedrick Creek	13.0	1.98	6.57
Greenwater River	175.39	52.00	3.37
American River	247.11	79.05	3.13
Entiat River	188.2	158.4	1.19
Trapper Creek	41.74	6.9	6.05
Middle Fork Teanaway River	62.71	26.0	2.41
Columbia Basin			
Naneum Creek	43.47	66.8	0.65
Umtanum Creek	1.56	52.0	0.03'
Little Klickitat River	54.84	78.0	0.70
Cummings Creek	7.2	19.03	0.38
North Fork Asotin Creek	41.83	42.0	0.99
Spring Creek	0.91	18.03	0.05'

* Note: Umtanum Creek and Spring Creek have sustained flows through contribution of groundwater input.

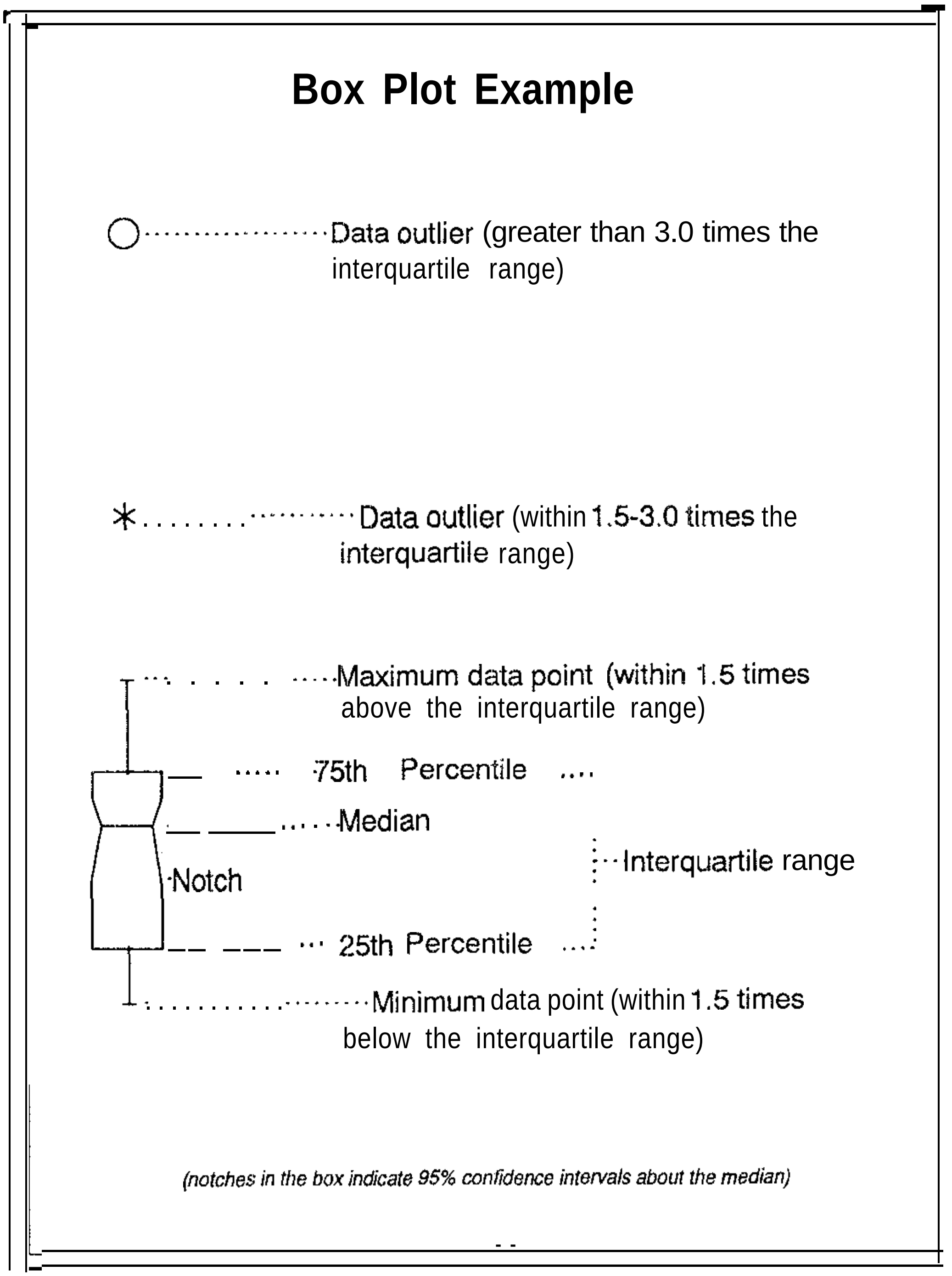

Figure 2. Interpretation of the notched boxplot characteristics

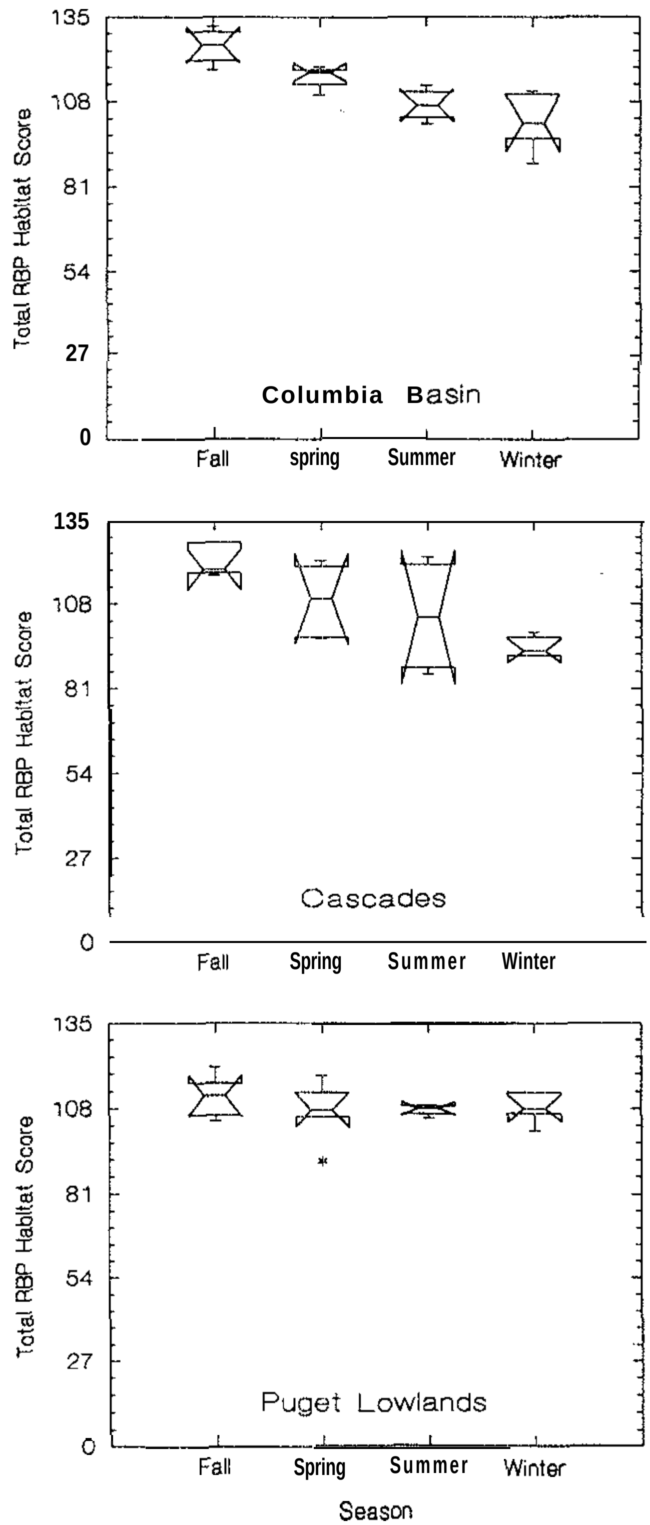

Figure 3. Total RBP habitat scores for each season in three ecoregions (Puget Lowland, Cascade, Columbia Basin) (n=6 observations per season).

Partitioned median habitat scores were highly consistent for Puget Lowland reference sites among all four seasons. Primary, secondary, and tertiary habitat parameters revealed no digressive trends (Figure 4). Partitioned habitat score distributions for the Cascades and Columbia Basin ecoregions showed the same general parameters trend as for the habitat score totals except for tertiary parameters (Figures 5 and 6). The seasonal habitat changes that were identified by this evaluation constitute physical constraints imposed on the macroinvertebrate community.

Benthic Macroinvertebrate Data Analysis

&trended Correspondence Analvsis (DCA)

Detrended correspondence analysis was performed on seasonal macroinvertebrate abundance data sets (Figures 7-10). The most distinct separation of ecoregion reference sites occurred for fall 1990, spring 1991, and summer 1991 benthic macroinvertebrate assemblages. The Cascades ecoregion invertebrate assemblages during the fall season were completely distinct from the other two ecoregions (Figure 7). Further statistical examination 'was limited to fall and spring assemblages. The summer benthic macroinvertebrate assemblage was not further analyzed because climatic conditions may have favored emergence for some populations and the remaining taxa collected during summer 1991 were similar to those collected in spring of 1991. A Columbia Basin stream outlier occurred in each of the fall 1990, spring 1991, and summer 1991 detrended correspondence analysis (Figures 7, 9, and 10). Naneum Creek (fall 1990), Umtanum Creek (spring 1991), and Little Klickitat River (summer 1991) were not closely clustered with other replicate Columbia Basin streams.

Two-Way Indicator Species Analvsis (TWINSPAN)

TWINSPAN was used to produce benthic macroinvertebrate taxa lists that discriminated between each ecoregion during fall 1990 and spring 1991. The two taxonomic lists represent benthic macroinvertebrates that defme an "indicator assemblage. " A summer 1991 indicator assemblage list was not produced because TWINSPAN results did not reveal strong clusters of taxa that were consistently associated with single ecoregions. Lack of distinct taxa assemblages in each ecoregion during summer 1991 could have been a result of insect emergence timing and, therefore, a transition period for macroinvertebrate population patterns. TWINSPAN analyses were based on the percentage composition of taxa at each reference station. Only taxa that had 5% or greater representation in a reference site community were included and considered dorninant in streams within an ecoregion. Frequency of taxa appearance was identified by percent representation of total sample abundance.

Taxa that are frequently present in an ecoregion during a particular season can be used as a "fingerprint" to describe the structural and functional characteristics of regional macroinvertebrate conditions. Thus the seasonal lists of macroinvertebrate occurrence frequencies reported in Appendix G provide some indication of biological expectation for other streams within the same ecoregion. A tabulation of represented functional attributes describes the expected macroinvertebrate conditions in an ecoregion during each season. Taxa included

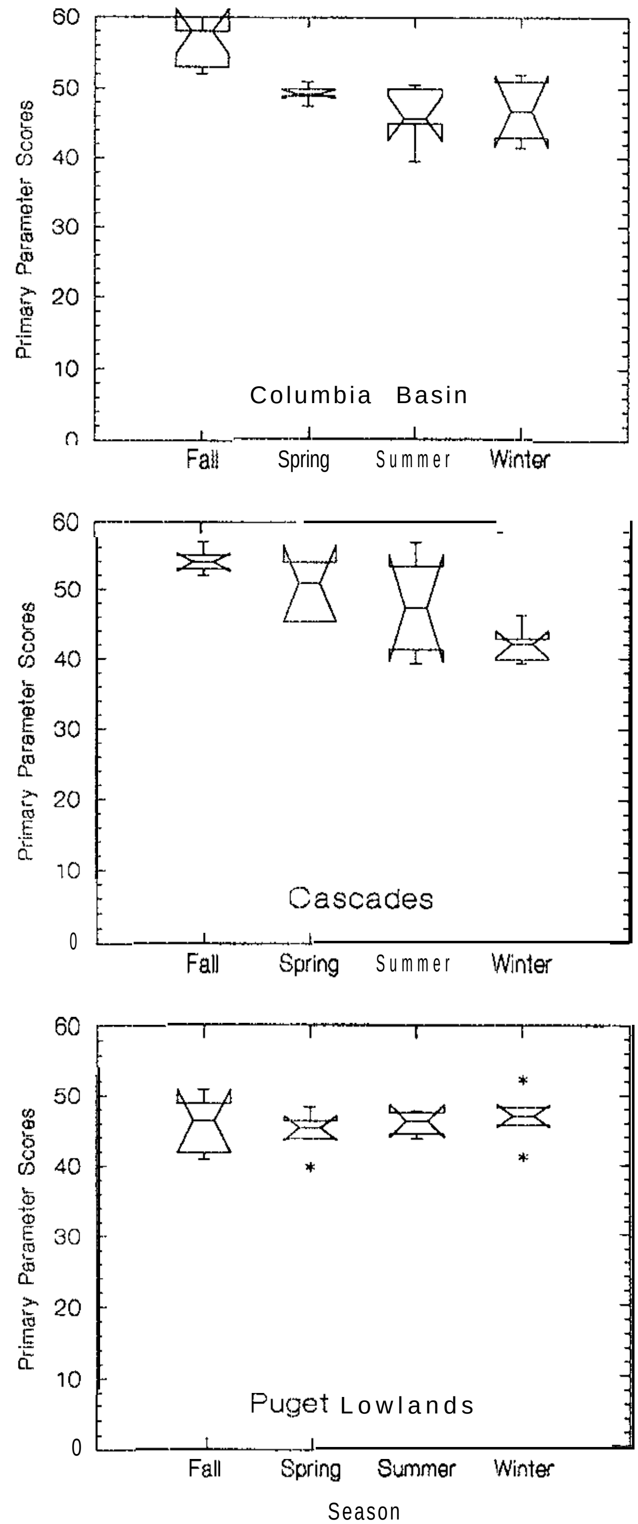

Figure 4. Primary RBP habitat parameter scores for each season in three ecoregions (Puget Lowland, Cascade, Columbia Basin) ($n = 6$ observations per season).

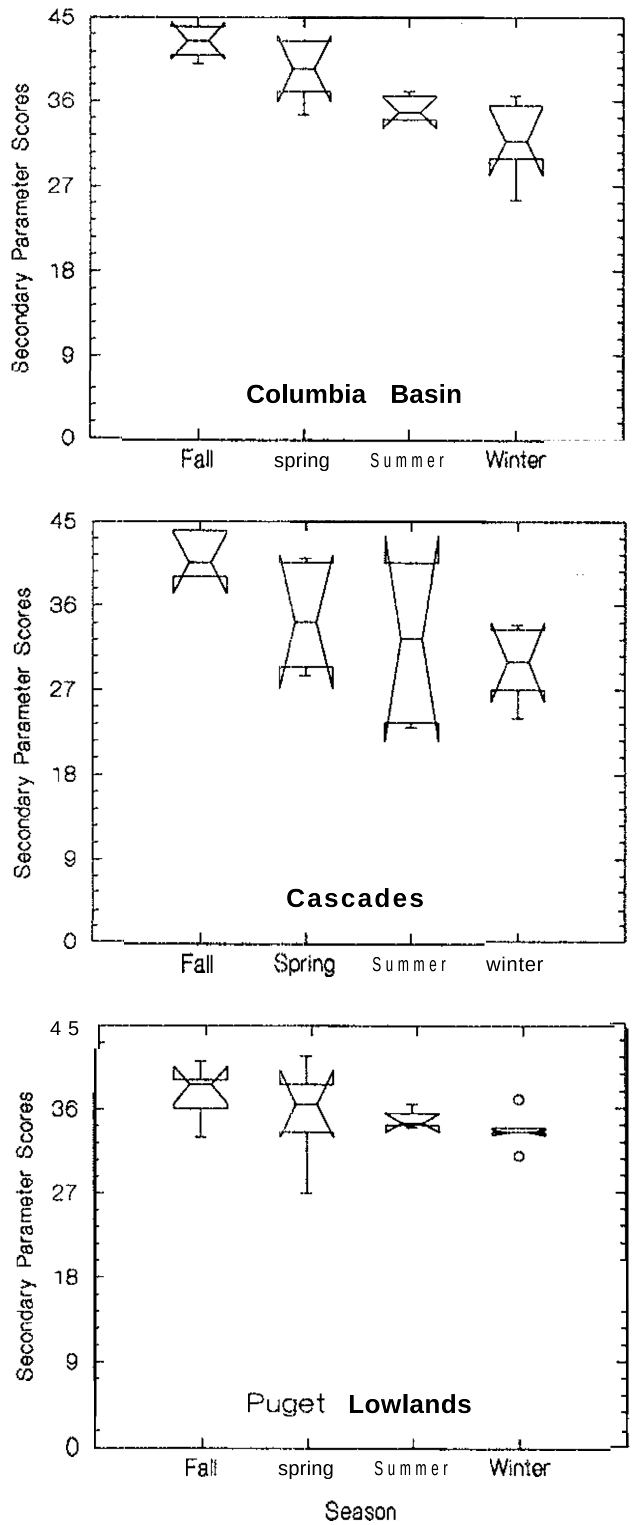

Figure 5. Secondary RBP habitat parameter scores for each season in three ecoregions (Puget Lowland, Cascade, Columbia Basin) (n=6 observations per season).

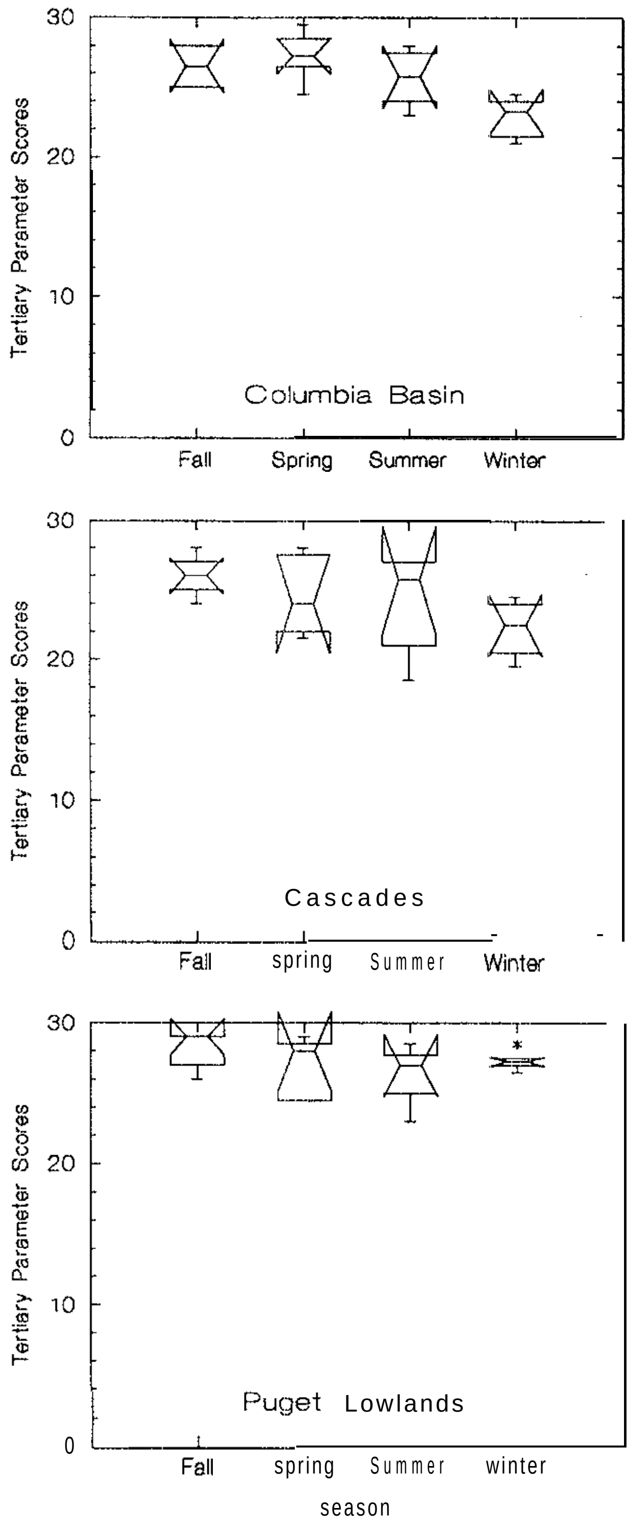

Figure 6. Tertiary RBP habitat parameter scores for each season in three ecoregions (Puget Lowland, Cascade, Columbia Basin) (n=6 observations per season).

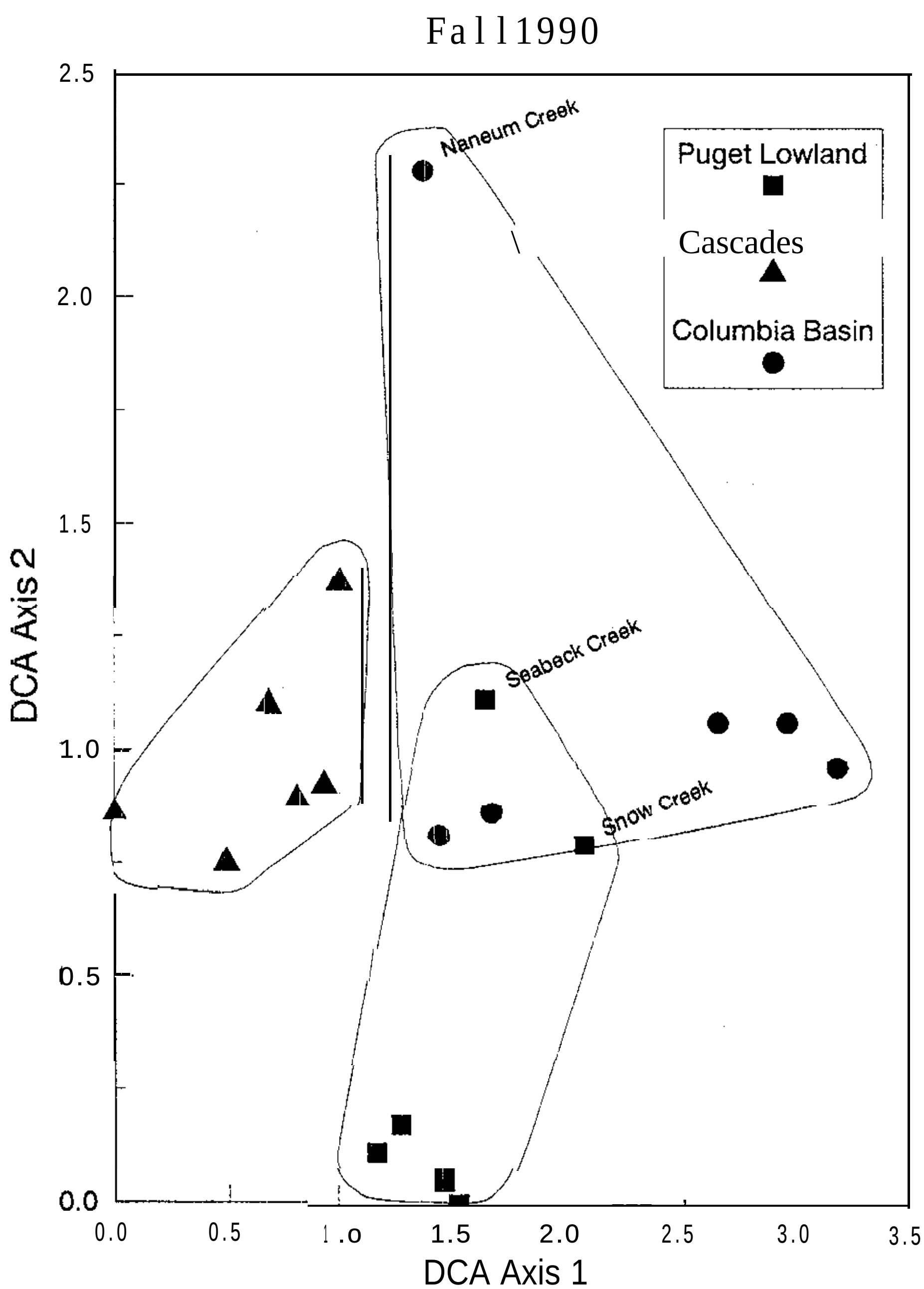

Figure 7. Detrended Correspondence Analysis of benthic macroinvertebrate communities during fall 1990.

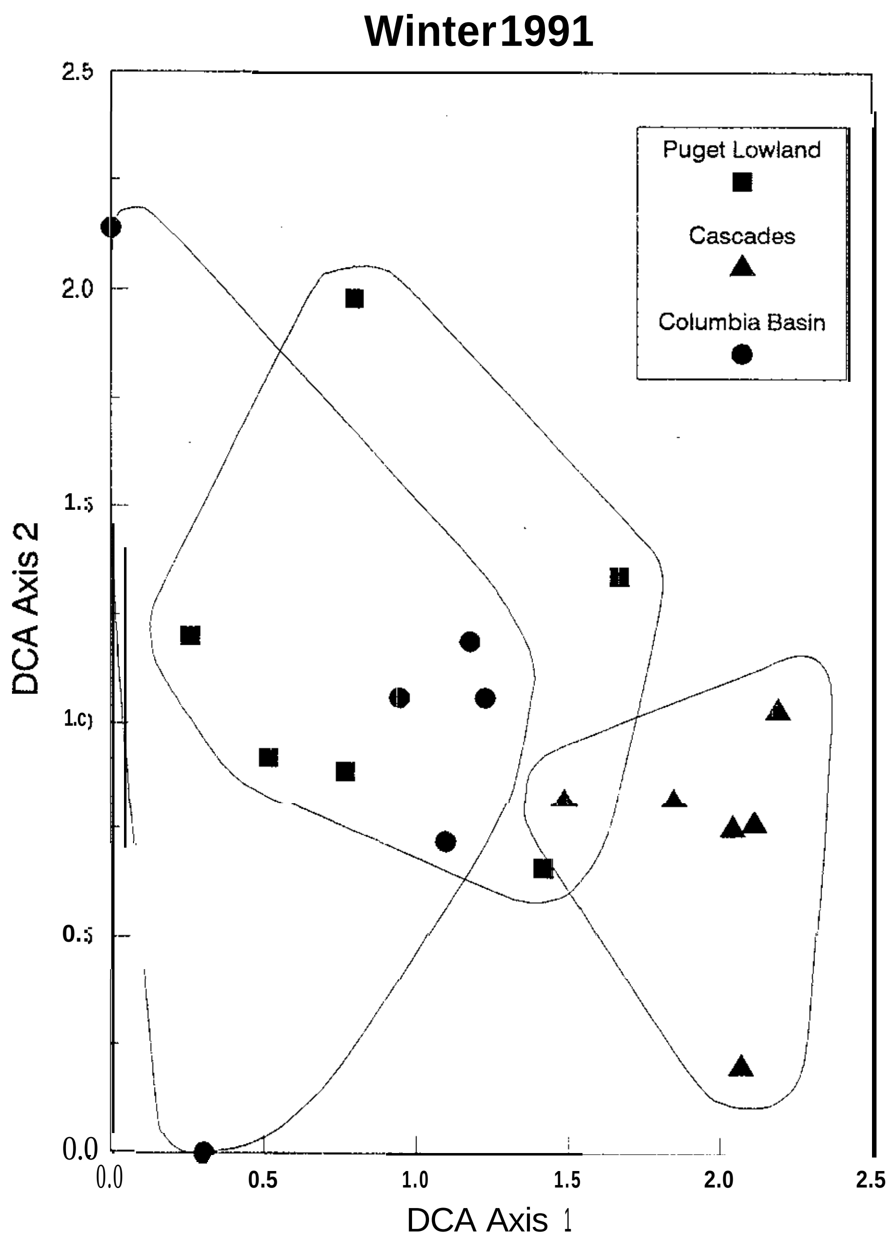

Figure 8. Detrended Correspondence Analysis of benthic macroinvertebrate communities during winter 199 1.

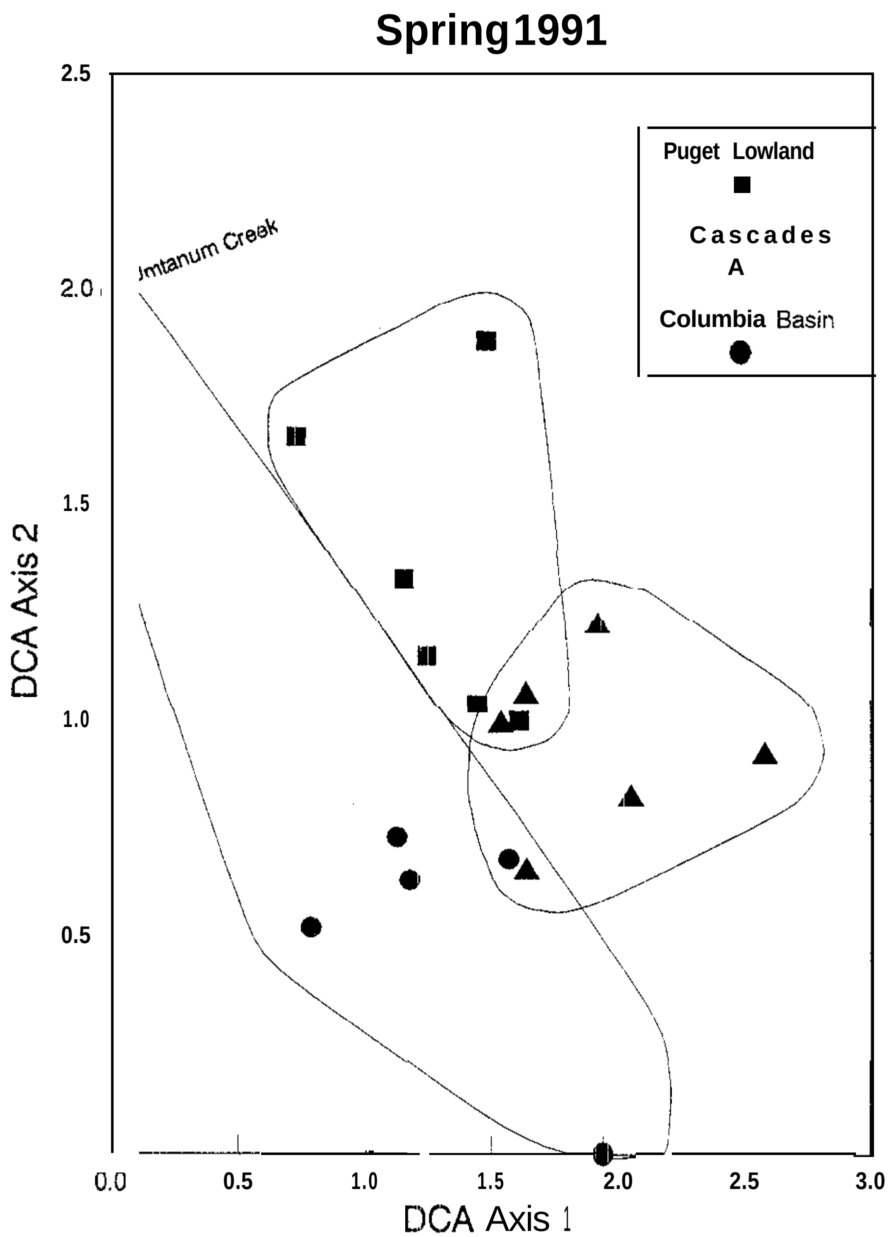

Figure 9. Detrended Correspondence Analysis of benthic macroinvertebrate communities during spring 1991.

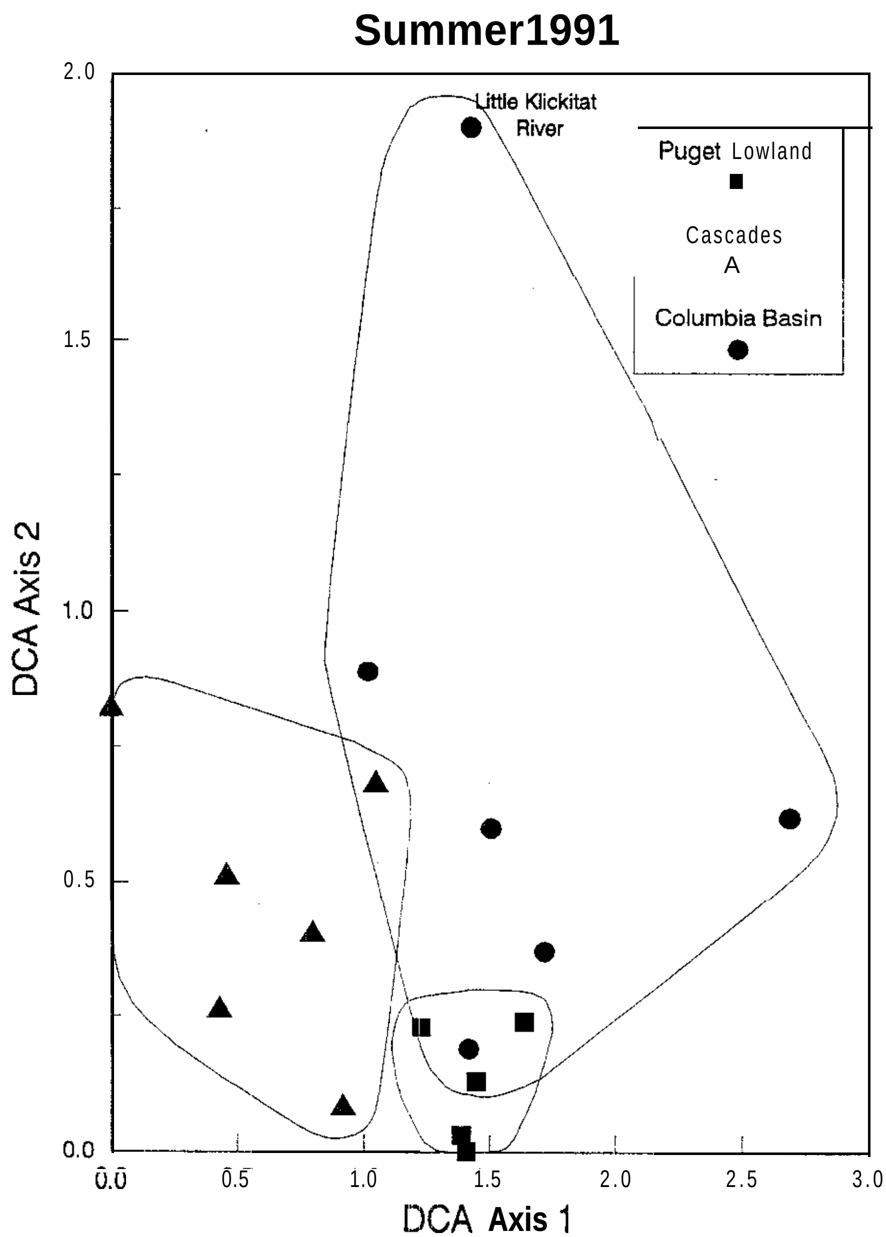

Figure 10. Detrended Correspondence Analysis of benthic macroinvertebrate communities during summer 1991.

in this description had 5% and greater representation of total relative abundance per site collection. These taxa were likely to be collected at a reference site and had a smaller likelihood of chance collection.

Ecoregion Indicator Assemblages

Taxa that were dominant and unique to the Puget Lowlands during fall 1990 are listed in Table 4. The assemblage includes a variety of Plecoptera (stoneflies), Trichoptera (caddisflies), and Diptera (midges, mosquitoes, blackflies). The functional description of Puget Lowlands macroinvertebrate indicator taxa during fall 1990 was that of a "shredder/collector-gatherer" community. The Columbia Basin indicator assemblage during fall 1990 included one mayfly, *Cinygmula #2*, and a host of other taxa, most of which were functionally classified as predators or scrapers. The Cascades ecoregion contained the highest representation of mayfly and stonefly taxa as unique indicators during fall 1990. Only a single dipteran taxon was characteristic of Cascades reference sites. Overall, the Cascades macroinvertebrate assemblage was functionally characterized as a "scraper/collector-gatherer" community.

The Puget Lowlands contained the smallest number of indicator taxa during the spring 1991 season (Table 5). As in fall 1990, mayfly indicator taxa were absent. This assemblage was functionally represented by all the primary and secondary macroinvertebrate consumers (shredders, scrapers, collector-filterers, collector-gatherers), but predators were most common. The Columbia Basin indicator assemblage in spring 1991 contained considerably more taxa than either the Puget Lowlands or Cascades. This ecoregion was characterized primarily by the "collector-gatherers" with good representation from other functional groups. The Cascades ecoregion, like the Puget Lowlands, produced an indicator assemblage dominated by predators.

A set of tables was prepared that describes the frequency of macroinvertebrate taxa occurrence both seasonally and spatially within an ecoregion (Appendix G). These tables identify "frequently present" and "occasionally present" taxa for each ecoregion by season. The utility of these taxonomic lists is to provide an indication of expected taxa in forested reference areas within each ecoregion. Appendix G also lists macroinvertebrates that appeared in all three ecoregions during the same season. These ubiquitous taxa represent tolerant or generalist benthic macroinvertebrates that may represent basic functional characterizations of all ecoregions surveyed in this project.

The functional classification of feeding strategies changed within each ecoregion as seasons progressed (Table 6). The most notable change in the Puget Lowlands reference condition occurred between fall 1990 and winter 1991 macroinvertebrate communities, when a community dominated by predators and collector-gatherers was joined by the other major functional groups (shredders, scrapers, and collector-filterers). Seasonal changes occurred in functional groups other than the predators and collector-gatherers which tended toward dominating the taxonomic composition of the Columbia Basin and Cascade ecoregions.

Biological Metrics: Rapid Bioassessment Protocols (RBP)

Single community measures such as diversity, total abundance, and species richness do not individually portray an accurate image of biological condition. However, combining a variety

Table 4. Unique taxa defined for each ecoregion: Puget Lowland, Columbia Basin, and Cascades (Fall 1990).

Puget Lowland

Plecoptera
- Capniidae
- *Doddsia*
- *Pteronarcella*
- *Nemoura*

Trichoptera
- *Hydatophylax*
- *Moselyana*
- *Micrasema*

Diptera
- Chironomidae (Pupa)
- *Glutops*
- Psychodidae (Pupa)
- *Ptychoptera*
- *Tipula*

Coleoptera
- *Cleptelmis*
- *Lara*

Amphipoda

Isopoda

Cascades

Ephemeroptera
- *Drunella doddsi*
- *Drunella spinifera*
- *Drunella coloradensis*
- *Eurylophella*

Plecoptera
- *Setvena*
- *Alloperla*
- *Doroneuria*
- *Haploperla*
- *Kathroperla*
- *Vtaperla*
- *Podmosta*

Trichoptera
- *Ochrotrichia*
- *Ecclisomyia*
- *Glossosoma*
- *Neophylax*
- *Parapsyche*
- *Psychomyia*

Diptera
- *Pericoma*

Columbia Basin

Ephemeroptera
- *Cinygmula #2*

Plecoptera
- *Kogotus*
- *Hesperoperla*
- Skwala
- *Diura*

Trichoptera
- *Cheumatopsyche*
- *Helicopsyche*
- *Polycentropus*

Diptera
- Dixa
- *Tabanus*

Coleoptera
- *Stenelmis*
- *Psephenus*

Megaloptera
- *Sialis*

Acari
- Hydracarina

Oligochaeta
- Naididae
- *Rhynchelmis*

Odonata (Zygoptera)
- *Argia*

Gastropoda
- *Physa*

Table 5. Unique taxa defined for each ecoregion: Puget Lowland, Columbia Basin, and Cascades (Spring 1991).

Puget Lowland

- Plecoptera
  - *Kogotus*
- Trichoptera
  - *Ceratopsyche*
  - *Ecclisomyia*
- Diptera
  - *Chelifera*
  - *Pseudolimnophila*
- Odonata
  - Anisoptera
- Gastropoda
  - *Juga*

Cascades

- Ephemeroptera
  - *Drunella coloradensis*
  - *Attenella*
- Plecoptera
  - *Skwala*
- Trichoptera
  - *Lepidostoma*
  - Limnephilidae (Pupa)
  - *Pedomoecus*
  - *Parapsyche*
- Diptera
  - *Atherix*
  - *Bibiocephala*
  - *Molophilus*
  - *Oreogeton*
- Lepidoptera
  - Pyralidae
- Acari
  - Hydracarina
- Turbellaria
  - Planariidae
- Nematoda

Columbia Basin

- Ephemeroptera
  - *Cinygmula #2*
  - *Ironodes*
- Plecoptera
  - *Cultus*
  - Skwala
  - *Amphinemura*
  - Capniidae
  - *Podmosta*
- Trichoptera
  - *Amiocentrus*
  - *Cheumatopsyche*
  - *Moselyana*
  - *Arctopsyche*
  - *Neophylax*
- Diptera
  - *Clinocera*
  - *Pericoma*
  - Dixidae
- Coleoptera
  - *Lara*
  - *Psephenus*
  - *Optioservus* (Adult)
  - *Heterlimnius*
  - *Heterlimnius* (Adult)
- Megaloptera
  - *Sialis*
- Oligochaeta
  - Naididae

Table 6. Macroinvertebrate community characterization using the trophic descriptions for frequently occurring taxa in each ecoregion.

Trophic Function	Puget Lowland.	Columbia Basin (no. taxa/ecoregion)	Cascades
Fall 1990			
Predators	8	8	7
Shredders	0	2	0
Scrapers	0	3	4
Collector-filterers	1	3	2
Collector-gatherers	4	7	4
Piercers	0	0	0
Winter 1991			
Predators	9	9	5
Shredders	2	4	3
Scrapers	4	1	3
Collector-filterers	3	4	2
Collector-gatherers	6	8	4
Piercers	0	0	0
Spring 1991			
Predators	4	6	7
Shredders	1	2	4
Scrapers	2	5	7
Collector-filterers	2	5	4
Collector-gatherers	3	10	8
Piercers	0	0	0
Summer 1991			
Predators	7	8	10
Shredders	2	8	1
Scrapers	2	6	3
Collector-filterers	1	2	3
Collector-gatherers	4	10	5
Piercers	0	0	0 6

of biological metrics or "biometrics" enables a more comprehensive evaluation of biological data sets because ineffectiveness of one biometric may be supplemented by more sensitive information in another. The biometrics used in this project are described in Appendix C. Each of the metrics describes an ecological aspect of the macroinvertebxate community collected from streams used in this survey. Seven of the eight original metrics listed in Plafkin *et* al. (1989) were used. The "Community Similarity Index" was not calculated because impaired site information was not available for comparison to the reference condition.

The biological metrics were calculated for each reference station in an ecoregion during each season. The biometric values were then displayed as box plots to compare the three ecoregions each season (Appendix H). All biometrics generally performed similarly throughout the seasons. Two biometrics were of questionable value on an ecoregional basis. The ratios of "Shredder Abundance/Total Number of Sample Organisms" were very low and thus would likely be of little value in detecting substantial changes in the reference communities. The ratios of "Total EPT Taxa Abundance/Chironomidae Abundance" produced acceptable distribution ranges for the Puget Lowlands and Columbia Basin ecoregions, but this metric was not well suited for the Cascades ecoregion during fall, winter, and spring due to the high variability. Seasonal variation of "Scraper Abundance/Collector-filterer Abundance" in the Cascade streams produced a wide distribution of values during winter 1991 , but improved in summer 1991. Problems with the ratio biometrics occur when either of the numerator or denominator do not reflect regional consistency within macroinvertebrate assemblage structural or functional attributes.

Some of the RBP III biometrics delineated ecoregional conditions quite clearly. Spring 1991 macroinvertebrate conditions were best described by the "Hilsenhoff Biotic Index," "EPT Index," and "Taxa Richness." The EPT Index was effective in separating ecoregion condition during fall 1990, while the Hilsenhoff Biotic Index was the only biometric that differentiated ecoregion conditions during winter 1991. The RBP II biometrics displayed strongest ecoregion delineation with "Family Richness" and "% Contribution of Dominant Family" during summer 1991. Family Richness was also a useful biometric in delineating biological conditions in spring 1991 benthic macroinvertebrate surveys.

Comparison of RBP III and RBP II Biological Metric Results

Family-level RBP II and generic-level RBP III biometric results were compared to determine the potential gain or loss of biological information associated with evaluating data at two different taxonomic levels. Three biometrics were compared: Taxa Richness, EPT Index, and Percent Contribution by the Dominant Taxon.

Differences between RBP III and RBP II metrics were reviewed by using the medians produced in box plots for each metric (Appendices H and I). The Cascades ecoregion generally contained the greatest differences for taxa richness and the EPT Index values when RBP III and RBP II were compared. The Puget Lowlands maintained the smallest score differences between the RBP III and II comparisons. Fall 1990 and summer 1991 macroinvertebrate RBP score differences were largest overall.

Quality Assurance Results

Distribution of the coefficients of variation within each ecoregion was generally below 20 percent. This meant that taxa richness estimates in replicate samples within a site varied by less than 20 percent. The trend toward lower coefficients of variation in taxa richness was consistent for fall 1990 and spring 1991 benthic macroinvertebrate samples (Figures 11 and 12, respectively). The root mean square of the coefficients of variation in each ecoregion was between 10 and 20 percent for the Cascades and Columbia Basin during both seasons. The ecoregional sampling precision estimate for the Puget Lowlands was higher for spring 1991 macroinvertebrate samples than the fall season. The same streams from each ecoregion had the highest coefficients of variation for fall 1990 and spring 1991. 'The outliers had a tendency to increase the regional replicate sampling precision estimate.

Principal Components Analysis (PCA) of Surface Water Parameters

Surface Water Parameter Associations

Principal components analysis was used for examining surface water quality and quantity data from two perspectives. First, parameter associations were defined by examining the spatial correlations displayed in Figure 13. Principal component 1 explained 43.6 percent of the data set variance and principal component 2 explained an additional 23.4 percent of the variance. A point of perspective was defined for this two-dimensional analysis of surface water parameters which shall be termed the "origin." The origin from which lines are drawn to each parameter indicates that nutrients and other chemical parameters are separated to the right on principal component 1. Left of the origin lies discharge, and to a lesser degree, dissolved oxygen and percent oxygen saturation. Relative position of the chemical/physical parameters to the origin indicates the nature of relationship between one or groups of parameters (direct or inverse relationship). Each of the surface water quality parameters were further examined by relating the parameter medians defined in notched box plots (Appendix J) to the ecoregion(s) that demonstrated significantly higher median estimates. Parameters to the right of the origin on principal component 1 had significantly higher medians in the Puget Lowland and Columbia Basin ecoregions. Median discharge was located to the left of the origin on principal component 1 and was significantly higher in the Cascades ecoregion streams.

An overall examination of surface water parameter separation revealed Puget Lowlands and Columbia Basin (valley/plains) ecoregion separation from the Cascades (mountains). Dissolved oxygen and percent oxygen saturation were similar among all three ecoregions and were spatially separated from the other two groups of parameters. Additionally, discharge seemed to be inversely related to the nutrients and most of the chemical parameters while water temperature was inversely related to dissolved oxygen concentrations. Explanation of the total variance for each principal component is defined by the chemical/physical parameter covariances. A list of these parameters and corresponding covariances (or eigenvectors) is displayed in Table 7. The eigenvectors are further grouped by similar loading values for each component and may, in part, discriminate logical regional surface water patterns.

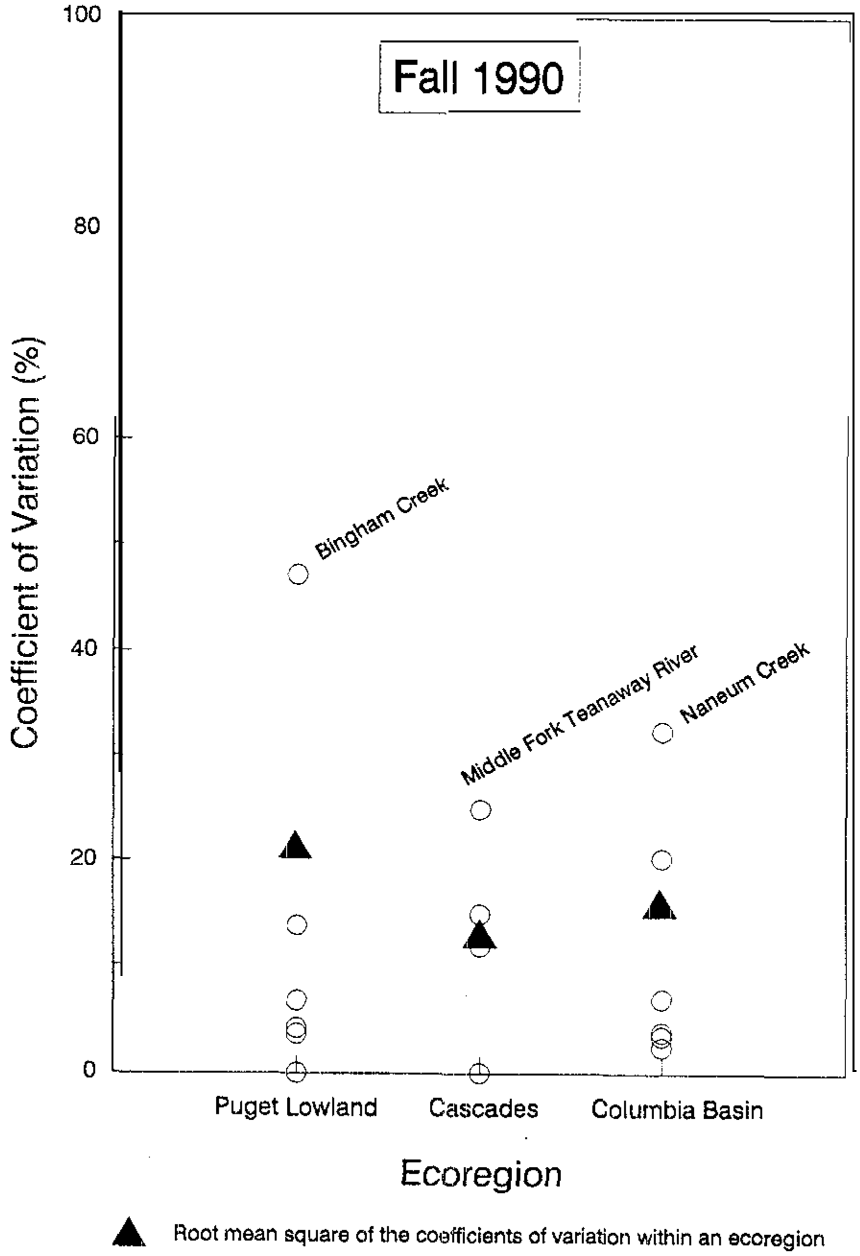

Figure 11. Distributions for coefficient of variation at each reference site within an ecoregion using total number of taxa from replicate macroinvertebrate samples (fall 1990).

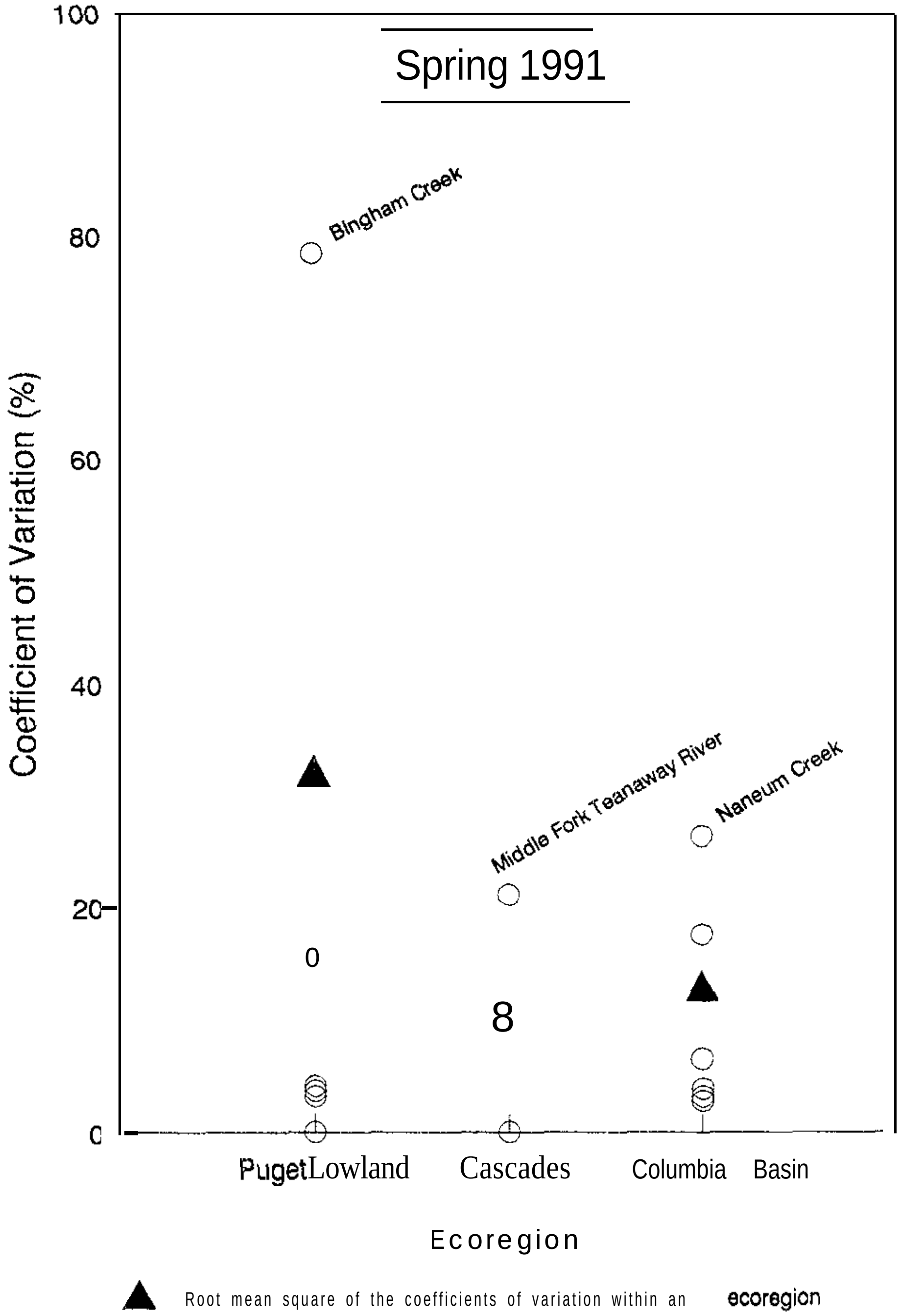

Figure 12. Distributions for coefficient of variation at each reference site within an ecoregion using total number of taxa from replicate macroinvertebrate samples (spring 1991).

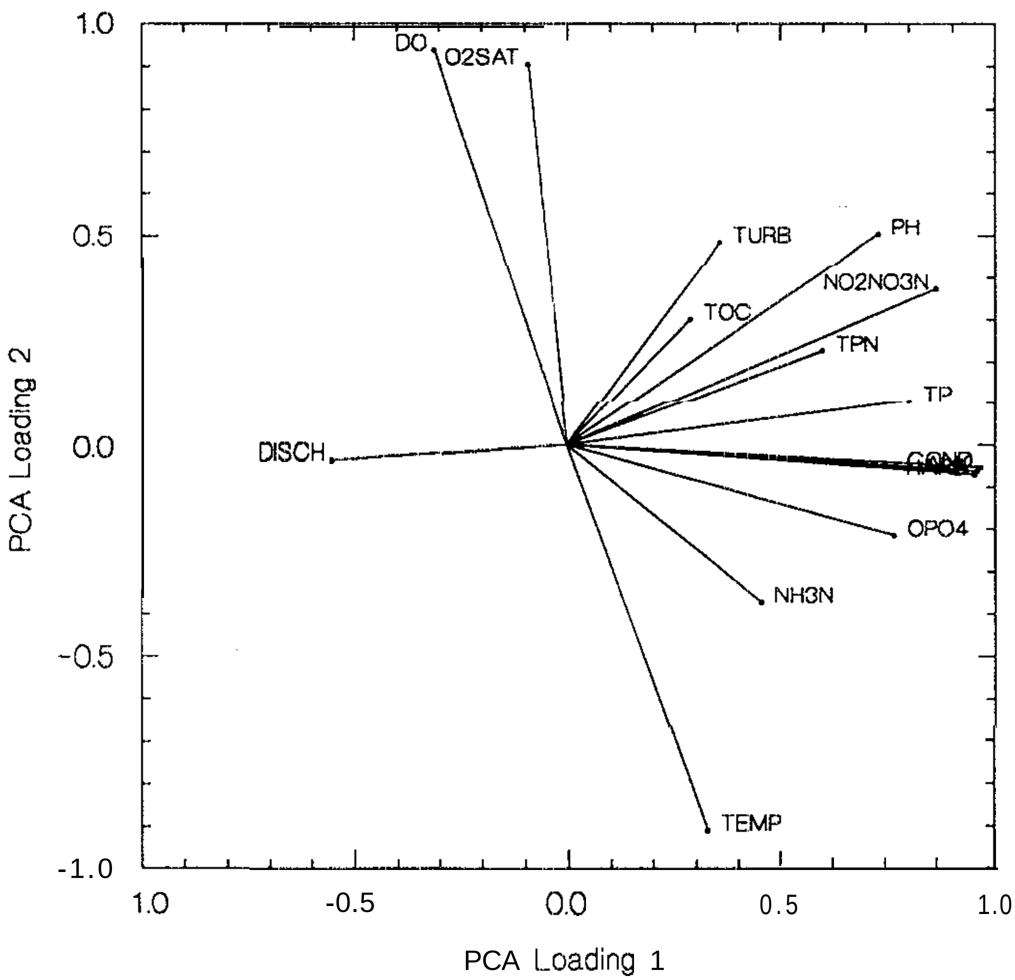

Figure 13. Principal components analysis parameter associations.

Table 7. Principal component analysis loadings for the surface water quality parameters measured at ecoregional reference sites.

Parameters	Loadings	
	Component 1	Component 2
Conductivity	0.965	-0.054
Alkalinity	0.957	-0.062
Hardness	0.952	-0.070
Nitrate+Nitrite-nitrogen	0.863	0.373
Total Phosphorus	0.801	0.1.05
Ortho-Phosphate	0.766	-0.215
pH	0.729	0.505
Total Persulfate Nitrogen	0.596	0.226
Ammonia-nitrogen	0.456	-0.372
Turbidity	0.357	0.485
Temperature	0.328	-0.912
Total Organic Carbon	0.287	0.301
Percent Oxygen Saturation	-0.091	0.904
Dissolved Oxygen	-0.311	0.937
Discharge	-0.548	-0.032

Note: The loadings are equivalent to the covariances which estimates each parameter's contribution to the explanation of the principal component variance.

PCA Ecoreaion-bv-Season Relationships

Principal components analysis was also used to generate a spatial plot of how ecoregion water quality varies by season (Figure 14). In this analysis, the Cascades ecoregion completely separated from the other two ecoregions. This pattern reflects the surface water quality parameter associations presented above. Seasonal water quality information partitioning distinguished the valley/plains ecoregions (Puget Lowlands and Columbia Basin) from the mountains (Cascades). Close association of the reference sites in valleys/plains ecoregions results from minimal differences in water quality measurements collected throughout the year.

Cluster Analvsis Using the Ecoreeion-bv-Season Matrix

Closer confirmation of ecoregion-by-season relationships was demonstrated with cluster analysis using the average-linkage method and Euclidean distances (Figure 15). The dendrogram produced from the cluster analysis confirmed that seasonal water quality conditions were more characteristic of a particular ecoregion. Specific seasonal associations within each ecoregion were also defined by cluster analysis. For instance, fall and winter surface water parameters were more similar to each other than to other seasons or other ecoregions in both the Cascades and Puget Lowlands.

DISCUSSION

Seasonal Habitat Scores

Evaluations of Puget Lowland reference sites were completed before the fall 1990 flood events began. There typically were higher surface water discharge rates at Puget Lowland stations following the summer due to increased rainfall frequency. Fall 1990 habitat conditions were improved with increased flow by creating additional useable instream habitat (Figure 3). The hydrologic year in Cascade streams culminated in an extreme low discharge period during winter 1991 while precipitation was bound in the form of snowpack:. The low winter 1991 habitat condition in the Cascades may also have been influenced by ice formation and general loss of useable instream habitat (Figure 3). The best Cascades ecoregion habitat score occurred during fall 1990 when sufficient water discharge and existing riparian and bank structure were major influences. The Columbia Basin ecoregion had similar seasonal patterns as those occurring within the Cascades. Riparian and bank structure habitat scores increased in the Columbia Basin during fall 1990 due to higher discharge rates that provided additional habitat availability (Figure 3).

Benthic Macroinvertebrate Patterns

&trended Correspondence Analvsis (DCA)

Detrended correspondence analysis identified fall 1990, spring 1991, and summer 1991 macroinvertebrate communities as more distinct within each ecoregion than were the winter 1991

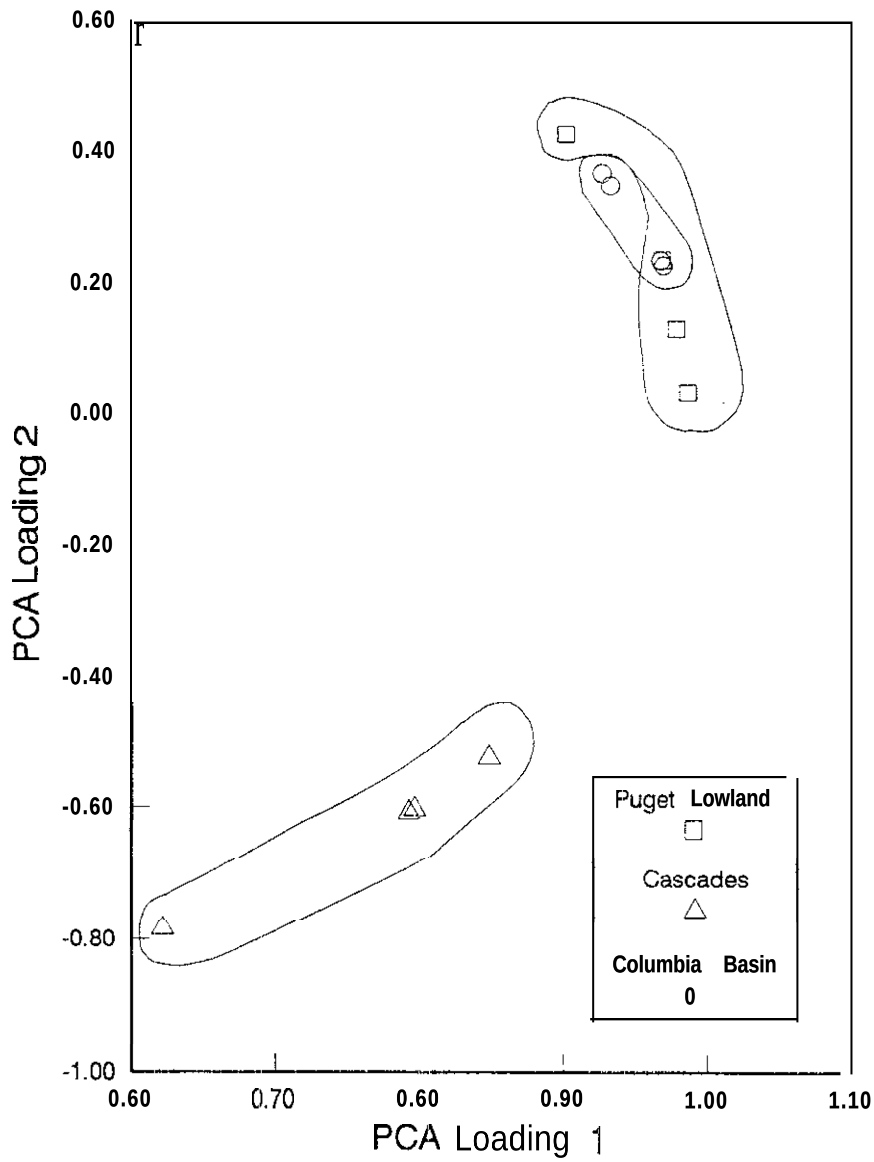

Figure 14. Principal components analysis of ecoregions by seasonal surface water quality information (fall, winter, spring, summer).

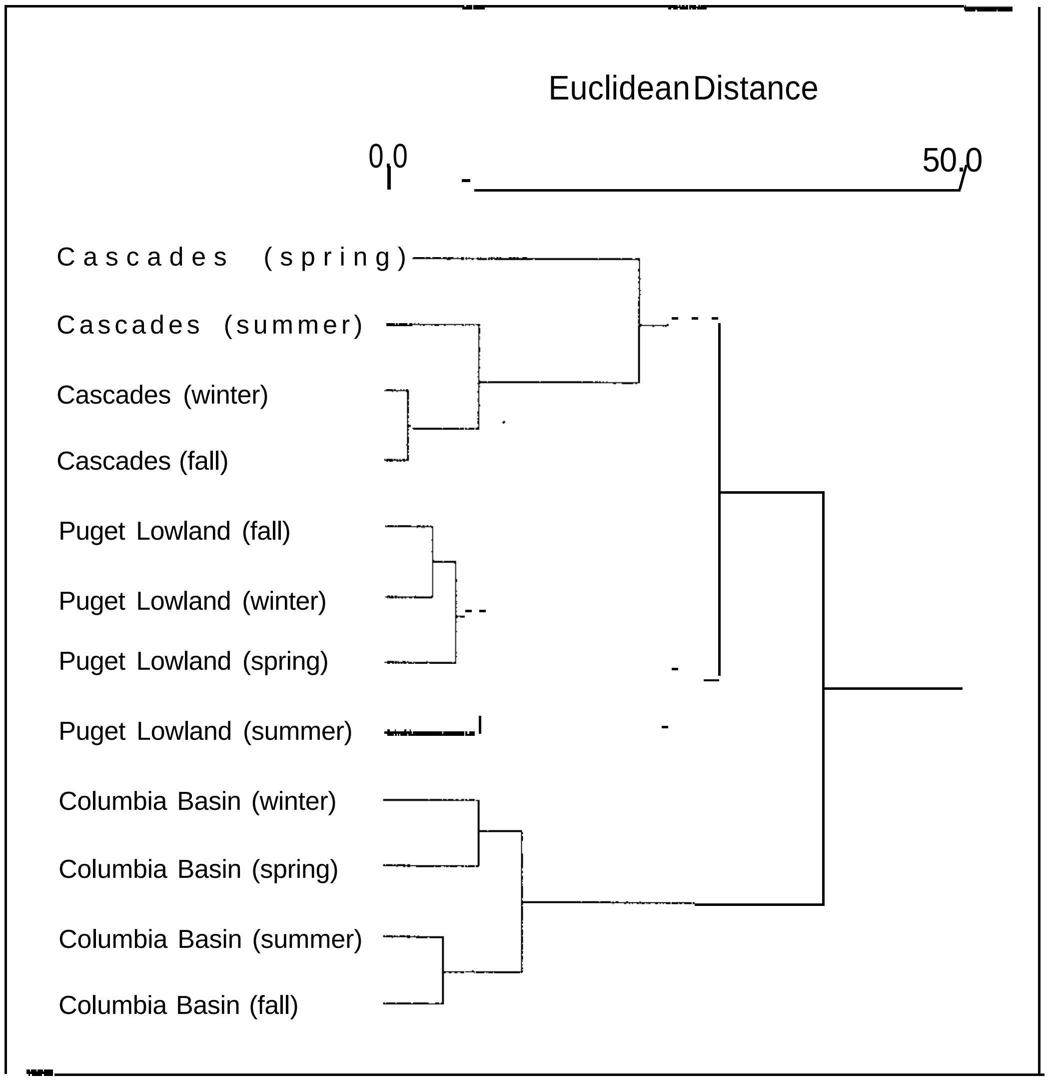

Figure 15. Cluster analysis (average-linkage) of seasonal ecoregion surface water quality parameters.

collections (Figures 7, 9, and 10). Hynes (1970) summarized the determinants of macroinvertebrate community structure and function that best explain regional distinctions as: current speed, temperature, substratum, and dissolved substances. Water temperature is known to be influenced by seasonality and altitude.

The distinction of the fall 1990 macroinvertebrate communities collected in each ecoregion may have been a result of good instream habitat conditions and the maturation of larval instars or winter emerging insects. Natural disturbance frequencies were also low in each ecoregion during fall 1990. Moderate surface water temperatures and favorable current velocities may have contributed to the distinction of each ecoregion's reference streams by allowing efficient macroinvertebrate use of instream resources.

The return of more stable physical habitat conditions in each ecoregion during spring 1991 marked another season where macroinvertebrate communities were most distinct. Numerous populations of macroinvertebrates appear from development of diapausing eggs during spring conditions. The development of diapausing eggs is strongly influenced by increasing surface water temperatures (Sweeney, 1984).

Winter 1991 reference conditions were marked by frequent natural disturbances in the Puget Lowlands (flooding and erosion), Columbia Basin (ice formation, peak flows), and Cascades (ice formation, snow load, torrential flows). Although some macroinvertebrates can withstand environmental extremes, life-cycle strategies such as egg diapause and hyporheic residence may occur during highly variable seasons (Vogl, 1980; Butler, 1984; Williams, 1984).

The summer season is typically a period of mass emergence of many species (Williams, 1984). Summer stream conditions within the Columbia Basin may become temperature limiting, which would promote life-cycle progression to emergence. The hyporheos also provides temporary refuge of cooler water temperatures for macroinvertebrate habitation (Butler, 1984; McElravy and Resh, 1991). Summer months may be appropriate for sampling when conditions are favorable. The regionally distinct summer macroinvertebrate assemblages determined by DCA demonstrate good biological characterization of ecoregions.

Two-Way Indicator Species Analysis: Indicator Assemblages

An important aspect of the distinct regional assemblages are their functional characteristics. The fall 1990 indicator macroinvertebrates collected from Puget Lowland reference sites were represented by shredders and collector-gatherers (Table 4). Energy input and available detrital material may have been primarily from allochthonous input; that is, organic material contributed from outside of the stream. Allochthonous input from riparian vegetation may also have encouraged the presence of certain feeding groups such as the shredders and collector-gatherers (Ward, 1984). The presence of many shredder and collector-gatherer taxa would infer that coarse particulate organic matter (CPOM) was abundant in Puget Lowland streams and also that microbial decay of freshly input material was efficient. Leaf processing by shredders produces fine particulate organic matter (FPOM) that is readily used by collector taxa. Microbial activity, including rates of processing, is known to be dependent on water temperature and the type of allochthonous material entering the stream (Cairns et *al.*, 1972; Cummins 1974; Lamberti and Moore, 1984; Merritt *et* al., 1984; Chergui and Pattee, 1990; Quinn and Hickey, 1990). The Columbia Basin and Cascades macroinvertebrate assemblages were also represented by many gatherer taxa during fall 1990, but were additionally characterized by "scraper" taxa (Table 4). These two ecoregions maintained three conditions that would favor a scraper/collector-gatherer community: 1) cooling water temperatures, 2) stable current regime, and 3) adequate photoperiod. Favorable flows and instream detrital retention encourage algal proliferation and an accumulated food base, respectively (Minshall et al., 1983; McCormick and Stevenson, 1991; Richardson and Neill, 1991).

The Puget Lowland reference streams experienced functional feeding group diversification during spring 1991 (Table 5), probably because of an increased variety in food resources and stabilizing instream habitat conditions. The collector-gatherers and predators were present during all seasons in the three ecoregions (Table 6). Alterations in other functional feeding groups were examined to provide evidence of seasonal change. Spring 1991 macroinvertebrate communities in the Columbia Basin and Cascades ecoregions progressed to shredder/collector-gatherer communities. Richardson (1991) demonstrated that increases in shredder abundance and biomass resulted from increased availability of food. Forest leaf litter may have been transported via snowmelt and gusting wind events to reference streams in these two ecoregions (Merritt *et al.*, 1984). Shredders were most active in the Cascades during spring 1991 while Columbia Basin shredders reached peak abundance in the summer. Also, adequate microbial processing of instream leaf litter may be seasonally delayed in these ecoregions until spring months. Decomposition rates of instream leaf litter vary depending on leaf type and may not be substantially decreased by a low water temperature. Cascade streams contained a larger number of predators than Columbia Basin streams. High substrate heterogeneity in Cascade streams may provide a variety of habitable substrate surfaces for prey items which sustain the diverse number of predator taxa (Peckarsky, 1984). The Baetidae were a ubiquitous taxon in Cascade region streams during spring 1991 and characteristically exhibit rapid generation succession (Anderson and Wallace, 1984). Predator populations may also have been sustained by this large prey population comprised by the baetid mayflies during the spring.

The taxa assemblages listed in Appendix G have been delineated as either frequently present or occasionally present in an ecoregion during each season. These lists were compiled to indicate the potential taxa that would likely he distributed within each ecoregion. Physical/chemical tolerances as well as individual pollution tolerances may largely account for those benthic macroinvertebrate community patterns (Beck, 1977; Harris and Lawrence, 1978; Hubbard and Peters, 1978; Surdick and Gaufin, 1978; Klemm *et al.*, 1990).

<u>Biological Metrics: Rapid Bioassessment Protocols (RBP)</u>

The biometric "shredder abundance/total number of sample organisms" was found to be exceptionally low in all ecoregions over all seasons (Appendix H). Shredder abundance should not be confused with the greater shredder taxa richness found under fall 1990 conditions in Puget

Lowland streams. Difficulty in shredder collection was the primary reason for this metric's poor performance. Collection timing is important because shredders appear with litter drop and population increases occur following leaf litter conditioning (Cummins *et al., 1989).* Loss of smaller shredder taxa during sample collection may be a function of the sampler net mesh size. Other surveys in Washington have similarly found shredder taxa and abundance to be represented in smaller quantities than other functional feeding groups (Munn *et al.*, 1990). A seasonally-focused, multihabitat sampling approach that includes detrital deposition zones may be needed to adequately characterize the shredder community.

The "total EPT taxa abundance/Chironomidae abundance" metric was not effective in the Cascades ecoregion. Variability for the metric was generally high during all seasons except summer 1991, when a reduction of EPT taxa abundance from adult emergence minimized variability. This metric should only be used in the Cascade ecoregion streams when depositional areas are included in the sampling approach. Chironomid taxa are not typically abundant in higher gradient, non-depositional stream areas (Hynes, 1970).

The "scraper abundance/collector-filterer abundance" metric indicated a wide distribution of values from Cascade reference streams during winter 1991. Improvement in metric performance in summer 1991 may have been due to increased abundance of the collector-filterer community. Increased particulate transport following late-spring/early-summer runoff in Cascade streams can provide the food base to sustain collector-filterer abundance (Minshall *et al.*, 1983). The scraper/collector-filterer abundance and EPT/Chironomidae abundance metrics were not able to discern mountain streams from the valleys/plains streams in the three ecoregions. Barbour *et* al. (1992) demonstrated this same difficulty with these two metrics.

Rapid Bioassessment Protocols: Comparison of RBP II and RBP III

Taxa richness and EPT index medians in the Cascades ecoregion had the largest RBP II and RBP III comparison differences. This occurred because Cascade streams have smaller taxonomic variety at the family level, but numerous genera within each family. Information loss in moving from a generic to familial level ultimately lowers sensitivity of these two metrics in impact assessment.

"Percent Contribution of Dominant Taxa" metric values were larger for RBP II than RBP III. The reason for this is that with RBP II, multiple genera were represented under one Family while RBP III retained information from a single Genus.

Biological screening level activities for detecting heavily impacted stream conditions can be addressed through use of RBP II. Resolution between expected biological conditions and impaired biological condition is probably detectable when using Family levels of taxonomic identification. Detection of subtle anthropogenic stream disturbances must use the RBP III methodology where generic taxonomic identification would provide adequate resolution of biological impairment.

Sampling Qualitv Assurance

Low site-specific coefficients of variation for taxa richness in both fall 1990 and spring 1991 indicated that single samples from a site may be adequate to characterize conditions. In terms of efficiency, single samples collected at each site would allow additional sites to be monitored for benthic macroinvertebrates. If the purpose for conducting bioassessments is to define general regional conditions, then single samples at each site following the cornpositing methodology outlined in this project would be appropriate. Near-field intensive surveys require replicate sampling, regardless, in order to evaluate ecological conditions with a much higher level of sampling precision. Intensive surveys may be performed in response to a compliance regulatory action and are, therefore, scrutinized more carefully.

One stream in each ecoregion is identified in Figures 11 and 12 as an extreme outlier beyond the root mean square of the coefficients of variation. The same streams were outliers in both the fall 1990 and spring 1991 samples (Puget Lowlands-Bingham Creek; Cascades-Middle Fork Teanaway River; Columbia Basin-Naneum Creek). Precision in replicate sampling was not satisfactory at these sites for the following possible reasons: 1) small number of taxa present in the stream, 2) a high frequency of natural stream disturbance, 3) an existing impact that was not immediately evident, or 4) a combination of the prior conditions. Sampling precision may have future application in further reference site selection procedures. Highly variable precision estimates within a candidate site may indicate a potential problem that warrants further investigation.

Surface Water Patterns

Surface Water Parameter Associations

The Columbia Basin surface waters were characterized by higher concentrations in hardness, alkalinity, ortho-phosphate, total phosphorus and high conductivities. Columbia Basin soils, primarily loess, may release substantial portions of adsorbed phosphorus nutrients in this ecoregion's surface waters (Omernik and Gallant, 1986). The origin of phosphorus associated with the soil would have been derived from organic decay, primarily grasses or grazing activity in previous decades. Loess is comprised of clay and various calcareous components which may have been historically deposited by overlying water or transported by wind in arid regions (Loomis, 1948; Tweney and Hughes, 1965). A naturally occurring hard pan layer of secondary carbonates may contribute to the high alkalinity and hardness concentrations in Columbia Basin surface waters. Deep percolation water that generally supplies a high percentage of base flow in surface waters during low flow seasons may transport ionic constituents derived from the hard pan soil layer to surface waters (Keller, pers. comm., 1992). Low stream discharges were observed during the summer season where deep percolation groundwater formed a larger percentage of the base flow, as well, contributed in greater percentage of flow to the alkalinity and hardness concentrations.

Puget Lowlands streams generally maintained higher nitrate+nitrite-nitrogen concentrations than streams in the other two ecoregions, perhaps due to input and processing of substantial quantities of leaf litter. There were many higher nitrate+nitrite-nitrogen concentration outliers in Columbia Basin stream observations (Appendix J4). These outliers were recorded from Spring Creek (Appendix F). Some eastern Columbia Basin streams, particularly those associated with palouse soils, carry much of the current and historic nonpoint source impacts due to agricultural practices. These high nitrate+nitrite-nitrogen concentrations perhaps reflect these land use impacts and may be an indelible effect on eastern Columbia Basin streams. The most distinct stream characteristic in the Cascades was discharge; a likely indicator of the increased precipitation, snowpack, and highly variable watershed sizes in this ecoregion.

Prevailing water quality conditions within each of the ecoregions can be related to observed biological conditions. The valley/plains regions contain streams that typically act as catchments from piedmont and mountainous areas. Accumulation of nutrients in lowland streams may be derived from higher elevation sources as well from regional land use impacts. Higher nutrient concentrations provide conditions under which periphyton communities flourish (Hynes, 1970). The potential for increased algal community development in Columbia Basin streams may, in part, explain the presence of season specific indicator taxa that belong to the scraper functional feeding group.

Prevalence of total organic carbon (TOC) in surface waters may be used as an estimate for the presence of consumable detrital material. An indirect relationship between presence of macroinvertebrate collectors and TOC concentrations may be defined if increase in macroinvertebrate collector presence is directly proportionate to TOC increases. TOC is a measure of organic particulates larger than 450 micromillimeters which corresponds to the subclasses of particles UPOM (ultrafine particulate organic matter) and smaller quantities of FPOM (tine particulate organic matter) (Cummins, 1980; APHA, 1989). Macroinvertebrate collectors use both FPOM and UPOM where there is a tendency toward increased concentrations in downstream reaches. The benthic macroinvertebrate collector community also increases proportionately with increases in the small organic particle size classes. Either external organic allochthonous (from outside the stream) input or macroinvertebrate shredder processing will contribute to production of this particle size class (Vannote et *al.*, 1980; Merritt et al., 1984; Wallace *et* al., 1991). TOC in Cascade reference streams was probably less prevalent because increased flow generally moves organic particulates further downstream before it is processed to this particle size class and a useable form by the collectors functional group (Newbold *et* al., 1981; Minshall *et al.*, 1983).

PCA Ecoregion-by-Season Relationshins

The spatial PCA plot of ecoregions by season in Figure 14 reveals the separation of reference site conditions, into valleys and plains versus mountains which confirms the water quality parameter associations described above. A cluster analysis of these same ecoregion-by-season variables revealed complete separation of all seasonal water quality information by ecoregion (Figure 15). Within the clusters, both fall 1990 and winter 1991 surface water parameters for the Cascades and Puget Lowlands reference streams were most similar. Fall and winter conditions in the Puget Lowlands streams were frequently disturbed by flooding, while Cascades streams experienced much more stable flow conditions. A chart was created to better define the physical/chemical relationships among the three ecoregions on a seasonal basis (Figure 16). These relationships were important determinants of biological community composition in each ecoregion's streams.

CONCLUSIONS AND RECOMMENDATIONS

Habitat Information

1. The qualitative habitat information collected for this project was suitable in detecting seasonal differences. However, this same information may not maintain an adequate degree of sensitivity for detecting subtle instream impacts.

2. Quantitative habitat evaluation should occur on an occasional basis at each reference station for purposes of calibrating the qualitative assessment methodology.

Benthic Macroinvertebrate Information

1. The sampling and analysis methods used in this project were effective in producing biological data that were supported by water quality and habitat information. Sampler type, net mesh sire, and sampling intensity are major determinants of the sampling efficiency in a benthic macroinvertebrate survey.

2. The ecoregion approach to defining reference sites produced a representative taxonomic list.

3. The most distinct seasons for benthic macroinvertebrate sampling were fall, spring, and summer. Early fall season sampling in the Puget Lowlands streams is recommended due to increasing flood frequencies when the wet season begins. Early spring sampling in the Cascades should be conducted prior to snowmelt (mid-May was suitable for sampling east side Cascade streams, while later March or April was suitable for west side Cascade streams). Timing of spring snowmelt will vary, therefore, sampling during this season should be determined by predicted climatological patterns for that year.

4. The Rapid Bioassessment Protocol biometrics that were inconsistent in performance were: 1) shredder abundance/total number of sample organisms, 2) total EPT taxa abundance/Chironomidae abundance, and 3) scraper abundance/collector-filterer abundance. The shredder/total sample abundance metric may be improved by either using a sampler type with a small net mesh sire (250 microns) or by adopting a multihabitat sampling approach.

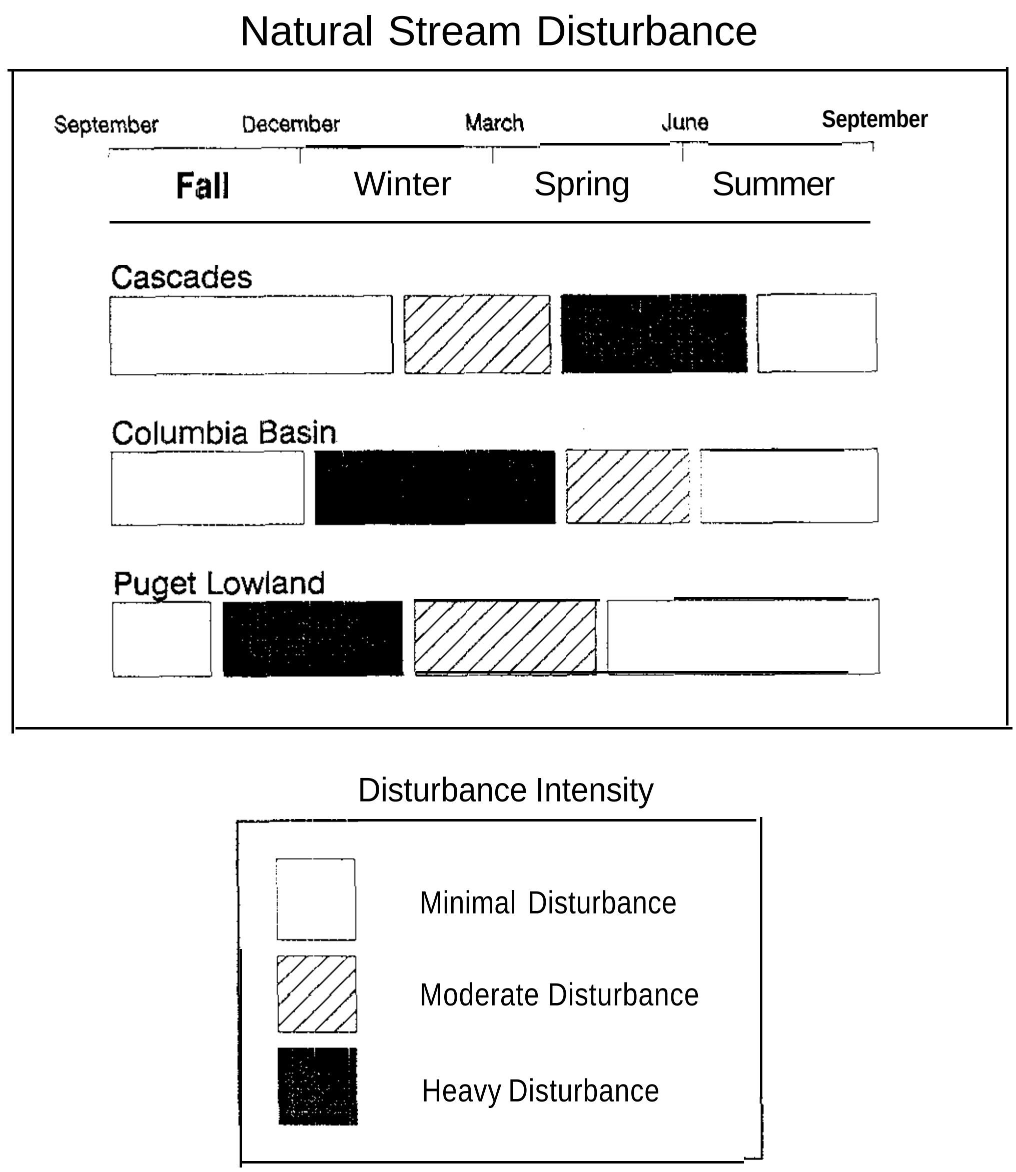

Figure 16. Natural stream disturbance intensity and seasonal timing in three ecoregions of Washington: Cascades, Columbia Basin, and Puget Lowlands.

5. RBP III biometrics that distinguished ecoregions were: Bilsenhoff Biotic Index, EPT Index, and Taxa Richness. All three of these biometrics distinguished ecoregion conditions during spring 1991, whereas only single biometrics differentiated the regional biological conditions in other seasons. Further modification and development of biometrics is required in order to determine ecoregion differences on a seasonal basis.

6. Site-specific and ecoregion-wide precision estimates for sample replicates indicate that single composite macroinvertebrate samples could be collected at a site. Coefficients of variation for taxa richness were generally less than 20 percent at each reference reach and for each ecoregion. Regional biological sampling could be expanded through reduced site-specific sampling and by sampling additional reference reaches.

General Synopsis

1. The modified Rapid Bioassessment Protocol sampling methodology for benthic macroinvertebrates was effective in discerning ecoregion community differences. The methods for collection, and analysis of macroinvertebrates are described in this document. Further modification of sampling methodology and development of additional biometrics may be necessary when impacted stream conditions are surveyed.

2. Similarity of reference stations between ecoregions in this project seemed to be related to two categories: mountains or valley/plains. In choosing reference stations for extrapolation to other streams within the ecoregion, attention should be given to maintaining reference site selection in mountain, Piedmont, or valley bottoms.

3. Cooperative monitoring among government agencies, private interests, and academic research institutions should be maintained. A standard database should be developed to promote sharing of biological assessment data.

Future Effort

1. The next logical phase of this project is an expansion of sampling to include a gradient of impacted sites for comparison to reference sites. This information is a necessary prerequisite to development of biocriteria.

2. Additional ecoregions should be monitored for biological, chemical, and physical characterization. Seasonal partitioning of biological monitoring into fall, spring, and summer periods is deemed most appropriate based on observations from the current project. Summer sampling should be conducted before substantial emergence activity appears. Drought years will accelerate insect life cycle progression that leads to early emergence.

3. An integrated freshwater ecosystem monitoring approach should be further refined to a systematic methodology. Simultaneous monitoring of physical, chemical, and biological attributes of a stream should be used to indicate relative “health” which would then guide future pollution abatement procedures and evaluation monitoring.

4. The number of chemical parameters monitored could be reduced by measuring one of a set of highly intercorrelated variables (i.e., alkalinity, hardness, conductivity, pH). Other useful diagnostic indicators of surface water quality are ortho-phosphate, ammonia-nitrogen, total organic carbon, temperature, and discharge.

5. Reference site selection in this project was constrained by having continuous annual accessibility which, in some cases, resulted in choices of mid-elevation reaches that had experienced historical impact and minor current activity. Future biological assessment activities should expand the number of reference sites by locating in roadless areas. Access to the more remote sites would be necessary during the fall and spring seasons when macroinvertebrate assemblages are considered most distinct between the ecoregions surveyed in this project. Stream reaches chosen for the Columbia Basin and Puget Lowland survey sites may presently be the least impacted. Cascade stream sites may be improved by locating in seasonally accessible roadless areas. Reference streams in ecoregions not surveyed in this project should be sited in the roadless areas initially.

6. Stream conditions in remote areas should be compared to the stream conditions surveyed in this project in order to evaluate possible information loss due to the accessibility of a stream.

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Appendix A

Rapid Bioassessment Protocol
Habitat Form

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category: Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow[a] at rep. low flow	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 16-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

(reprinted from Plafkin et al

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category: Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	____	____	____	____

Score

Appendix B

List of Useful Taxonomic Macroinvertebrate Keys

General Taxonomic Kevs

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Jensen, S.L. 1966. The Mayflies of Idaho (Ephemeroptera). Department of Zoology and Entomology, University of Utah. Master's Thesis. 367 p.

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Baumann, R.W., A.R. Gamin, and R.F. Surdick. 1977. The stonflies (Plecoptera) of the Rocky Mountains. Mem. Amer. Entom. Soc. 31: l-208.

Hoppe, G.N. 1938. Plecoptera of Washington. University of Washington Publications in Biology 4(2): 139-174.

Hynes, H.B.N. 1988. Biogeography and origins of the North American Stoneflies (Plecoptera). Mem. Entom. Soc. Can. 144: 31-38.

Jewett, S.G., Jr. 1959. The stoneflies (Plecoptera) of the Pacific Northwest. Oregon State Monographs 3: l-95.

Stark, B.P. and A.R. Gaufin. 1976. The nearctic Genera of Perlidae (Plecoptera). Misc. Publ. Entomol. Soc. Amer. 10(1): l-80.

Stark, B.P., S.W. Szczytco and B.C. Kondratieff. 1988. The *Cultus decisus* complex of Eastern North America (Plecoptera: Perlodidae). Proc. Entomol. Soc. Wash. 90(1): 91-96.

Stewart, K.W. and B.P. Stark. 1989. Nymphs of North American stonefly genera (Plecoptera). Thomas Say Foundation Series, Volume 12, Amer. Entomol. Soc., Hyatsville, MD.

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Newell, R.L. and D.S. Potter. 1973. Distribution of some Montana caddisflies. Proc. Montana Acad. Sci. 33: 12-21.

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Ross, H.H. 1956. Evolution and classification of the mountain caddisflies. The University of Illinois Press, Urbana, IL. 213 pp.

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Diptera: General

McAlpine, J.F., B.V. Peterson, G.E. Shewell, H.J. Teskey, J.R. Vockeroth, and D.M.Wood, Eds. 1981. Manual of Nearctic Diptera, Volume 1. Research Branch, Agriculture Canada. Biosystematics Research Institute, Ottawa, Ontario. 674 pp.

McAlpine, J.F., B.V. Peterson, G.E. Shewell, H.J. Teskey, J.R. Vockeroth, and D.M.Wood, Eds. 1987. Manual of Nearctic Diptera, Volume 2. Research Branch, Agriculture Canada. Biosystematics Research Institute, Ottawa, Ontario. pp. 675-1332.

Diptera: Chironomidae

Mason, W.T., Jr. 1968. An introduction to the identification of chironomid larvae. Federal Water Pollution Control Administration, Division of Pollution Surveillance, Cincinnati, OH. 89 pp.

Oliver, D.R., D. McClymont, and M.E. Roussel. 1978. A key to some larvae of Chironomidae (Diptera) from the Mackenzie and Porcupine River Watersheds. Fisheries and Marine Service, Technical Report No. 791. Winnipeg, Manitoba. 73 pp.

Roback, S.S. 1971. The subfamily Tanypodinae in North America. Monogr. Acad. Nat. Sci. Philad. 17: l-410.

Simpson, K.W. 1982. A guide to basic taxonomic literature for the genera of North American Chironomidae @iptera)-adults, pupae, and larvae. New York State Museum, Bulletin No. 447. Albany, New York. 43 pp.

Wiederholm, T., Ed. 1983. Chironomidae of the Holarctic region keys and diagnoses: Part l-Larvae. Entomologica Scandinavica, Supplement No. 19. 457 pp.

Diptera: Simuliidae

Adler, P.H. and K.C. Kim. 1986. The blackflies of Pennsylvania (Simuliidae, Diptera): bionomics, taxonomy, and distribution. The Pennsylvania State University, College of Agriculture, Agricultural Experiment Station, Bulletin 856. University Park, PA. 88 pp.

Kim, K.C. and R.W. Merritt, Eds. 1987. Black flies: ecology, population management, and annotated world list. The Pennsylvania State University. University Park, PA. 528 pp.

Other Taxonomic Keys

Burch, J.B. 1972. Biota of Freshwater Ecosystems Identification Manual No. 3. Freshwater sphaeriacean clams (Mollusca-Pelecypoda) of North America. Museum of Zoology, The University of Michigan, Ann Arbor, Michigan. 31 pp.

Hobbs, H.H., Jr. 1972. Biota of Freshwater Ecosystems Identification Manual No. 9. Crayfishes (Astacidae) of North and Middle America. Smithsonian Institution, Washington, D.C. 173 pp.

Holsinger, J.R. 1972. Biota of Freshwater Ecosystems Identification Manual No. 5. The freshwater amphipod crustaceans (Gammaridae) of North America. Old Dominion University, Norfolk, Virginia. 89 pp.

Kenk, R. 1972. Biota of Freshwater Ecosystems Identification Manual No. 1. Freshwater planarians (Turbellaria) of North America. Smithsonian Institution, Washington, D.C. 81 pp.

Appendix C

Description of
Rapid Bioassessment Biometrics

(reprinted from Plafkin et al., 1989)

Riffle/Run Sample

Metric 1. Species Richness

Reflects health of the community through a measurement of the variety of taxa (total number of genera and/or species) present. Generally increases with increasing water quality, habitat diversity, and/or habitat suitability. Sampling of highly similar habitats will reduce the variability in this metric attibutable to factors such as current speed and substrate type. Some pristine headwater streams may be naturally unproductive, supporting only a very limited number of taxa. In these situations. organic enrichment may result in an increase in number of taxa (including EPT taxa).

Metric 2. Modified Hilsenhoff Biotic Index

Tolerance values range from 0 to 10, increasing as water quality decreases. The index was developed by Hilsenhoff (1987b) to summarize overall pollution tolerance of the benthic arthropod community with a single value. This index was developed as a means of detecting organic pollution in communities inhabiting rock or gravel riffles, and has been modified for this document to include non-arthropod species as well, on the basis of the biotic index used by the State of New York (Bode 1988).

Although Nils&offs biotic index was originally developed for use in Wisconsin, it is successfully used by several States and should prove reliable for extensive use. *requiring regional modification in some instances.* Alternative tolerance classifications and biotic indices have also been developed by some State agencies (Appendix C). The formula for calculating the Biotic Index is:

$$HBI = \Sigma \frac{x_i t_i}{n}$$

where

x_i = number of individuals within a species
t_i = tolerance value of a species
n = total number of organisms in the sample

Although it may be applicable for other types of pollutants. use of the HBI in detecting non-organic pollution effects has not been thoroughly evaluated. The State of Wisconsin is conducting a study to evaluate the ability of Hilsenhoff's index to detect non-organic effects. Winget and Mangum (1979) have developed a tolerance classification system applicable to the assessment of nonpoint source impact. Additional biotic indices are also listed in U.S. EPA (1983).

Metric 3. Ratio of Scraper and Filtering Collector Functional Feeding Groups

The Scraper and Filtering Collector Functional Group ratio reflects the riffle/run community foodbase and provides insight into the nature of potential disturbance factors. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source. The predominant feeding strategy reflects the type of impact detected.

A description of the Functional Feeding Group concept can be found in Cummins (1973). Genus-level Functional Feeding Group designations ‘for most aquatic insects can be found in Merritt and Cummins (1984).

The relative abundance of Scrapers and Filtering Collectors in the riffle/run habitat provides an indication of the periphyton community composition and availability of suspended Fine Particulate Organic Material (FPOM) associated with organic enrichment. Scrapers increase with increased abundance of diatoms and decrease as filamentous algae and aquatic mosses (which cannot be efficiently harvested by Scrapers) increase. However, filamentous algae and aquatic mosses provide good attachment Sites for Filtering Collectors, and the organic enrichment often responsible for overabundance of filamentous algae provides FPOM utilized by the Filterers.

Filtering Collectors are also sensitive to toxicants bound to fine panicles and may decrease in abundance when exposed to sources of such bound toxicants (Cummins 1987). The Scraper to Filtering Collector ratio may not be a good indication of organic enrichment if adsorbing toxicants are present. This situation is often associated with point source discharges where certain toxicants adsorb readily to dissolved organic matter (DOM) forming FPOM during flocculation. Toxicants thus become available to Filterers via FPOM. In these instances the HBI and EPT Index may provide additional insight. Qualitative field observations on periphyton abundance may also be helpful in interpreting results.

Metric 4. Ratio of EPT and Chironomidae Abundances

The EPT and Chironomidae abundance ratio uses relative abundance of these indicator groups as a measure of community balance. Good biotic condition is reflected in communities having a fairly even distribution among all four major groups and with substantial representation in the sensitive groups Ephemeroptera, Plecoptera, and Trichoptera. Skewed populations having a disproportionate number of the generally tolerant Chironomidae relative to the more sensitive insect groups may indicate environmental stress (Ferrington 1987). Certain species of some genera such as *Cricotopus* are highly tolerant (Lenat 1983, Mount et al. 1984), opportunistic, and may become numerically dominant in habitats exposed to metal discharges where EPT taxa are not abundant, thereby providing a good indicator of toxicant stress (Winner et al. 1980). Clements et al. (1988) found that mayflies were more sensitive than chironomids when exposed to 15 to 32 $\mu g/L$ of copper.

Chironomids tend to become increasingly dominant in terms of percent taxonomic composition and relative abundance along a gradient of increasing enrichment. or heavy metals concentration (Ferrington 1987).

An alternative to the ratio of EPT and Chironomidae abundance metric is the Indicator Assemblage Index (IAI) developed by Shackleford (1988). 'The IAI integrates the relative abundances of the EPT taxonomic groups and the relative abundances of chironomids and annelids upstream and downstream of a pollutant source to evaluate impairment. The IAI may be a valuable metric in areas where the annelid community may fluctuate substantially *in* repsonse to pollutant stress.

Metric 5. Percent Contribution of Dominant Taxon

The percent contribution of the numerically dominant taxon to the total number of organisms is an indication of community balance at the lowest positive taxonomic level. (The lowest positive taxonomic level is assumed to be genus or species in most instances.) A community dominated by relatively few species would indicate environmental stress. (If the Pinkham and Pearson Similarity Index is used as a community similarity index for metric number 7, this metric may be redundant.) Shackleford (1988) has modified this metric to reflect "dominants in common" (DIC) utilizing the dominant five taxa at the stations of comparison.

This DIC approach is based on the original metric used in earlier drafts of this RBP document. The DIC will provide a measure of replacement or substitution between the reference community and the downstream station. The purpose of the modification to "percent contribution of dominant taxon" used in RBP III (and RBP II) is to focus on evenness/redundancy of the benthic community regardless of taxa composition. Compositional shifts are measured by other metrics such as the community similarity indices.

Metric 6. EPT Index

The EPT Index generally increases with increasing water quality. The EPT Index is the total number of distinct taxa within the orders Ephemeroptera, Plecoptera, and Trichoptera. This value summarizes taxa richness within the insect orders that are generally considered to be pollution sensitive.

Headwater streams which are naturally unproductive may experience a" increase in taxa (including EPT taxa) in response to organic enrichment. In this situation, a "missing genera" approach may be more valuable. Shackleford (1988) uses a "missing genera" metric to evaluate the loss of EPT taxa from upstream to downstream to avoid the complication in data interpretation resulting from the addition or replacement of genera.

CPOM Sample

Metric 8. Ratio of Shredder Functional Feeding Group and Total Number of Individuals Collected

Also based on the Functional Feeding Group concept, the abundance of the Shredder Functional Group relative to the abundance of all other Functional Groups allows evaluation of potential impairment as indicated by the CPOM-based Shredder community. Shredders are sensitive to riparian zone impacts and are particularly good indicators of toxic effects when the toxicants involved are readily adsorbed to the CFQM and either affect the microbial communities colonizing the CPOM or the Shredders directly (Cummins 1987).

The degree of toxicant effects on Shredders versus Filterers depends on the nature of the toxicants and the organic particle adsorption efficiency. Generally, as the size of the particle decreases, the adsorption efficiency increases as a function of the increased surface to volume ratio (Hargrove 1972). As stated in metric 3, water-borne toxicants are readily adsorbed to FPOM. Toxicants of a terrestrial source (e.g., pesticides, herbicides) accumulate on CPOM prior to leaf fall thus having a substantial effect on Shredders (Swift et al. 1988a and 1988b). The focus of this approach is on a comparison to the reference community, which should have an abundance and diversity of Shredders representative of the particular area under study. This allows for an examination of Shredder or Collector "relative" abundance as indicators of toxicity.

Appendix D

Reference Site Descriptions

By
Henry L. Dietrich

Puget Lowlands Ecoregion Reference Sites

BINGHAM CREEK

The Bingham Creek site is within second growth, timber and located on commercial forest lands. The sample station is approximately 650 feet above mean sea level in elevation. Upstream drainage basin area is 4.6 square miles. The basin terminates in the surrounding hills, 2 miles upstream from the sampling site. Highest elevations within the Bingham Creek drainage reach 2,600 feet. Bingham Creek is a tributary of the East Fork Satsop River.

Stream substrate within the sample reach contains cobble, gravel, and silty areas. Large diameter woody debris is present along and within the stream. The reference reach was nearly dry during water quality and benthic macroinvertebrate sampling in May. The sample reach was dry in June and August. A large marsh persists just downstream of the reference reach. Outflow from this marsh maintains stream flow in the lower reaches of Bingham Creek year round.

Forests in the vicinity of the sample station are dominated by Douglas fir (*Pseudotsuga* menziesii) which are 1-2 feet diameter. Larger well rotted stumps are visible above the forest floor. Other tree species observed include western hemlock *(Tsuga heterophylla),* big-leaf maple (*Acer macrophyllum),* red alder (*Alnus rubra),* and black cottonwood (*Populus Trichocarpa*). Tall shrubs include osobeny *(Oemleria cerasiformis*), vine maple (*Acer circinatum*), and ninebark (*Physocarpus capitutus* at this site). Lower shrubs include Oregon grape (*Berberis nervosa),* salal *(Gaultheria shallon*), baldhip rose *(Rosa gymnocarpa*), red huckleberry *(Vaccinium parvifolium*), and salmonberry (*Rubus spectabilis*) Herbs include sword-fern *(Polystichum munitum),* false lily-of-the-valley *(Maianthemum dilatatum*), rattlesnake-plantain *(Goodyera oblongifolia*), bleeding heart (*Dicentra formosa*), pig-a-back-plant *(Tolmiea menziesii),* and Siberian miner's lettuce *(Montia sibirica*).

SNOW CREEK

The sample reach on Snow Creek is 300 feet above mean sea level. Approximately 6 miles upstream, the basin reaches its highest point at Mount Zion,, about 4,250 feet in elevation. Drainage area upstream from the sample reach is 11.4 square miles. The stream substrate is primarily cobble, gravel, and sand. However, a few areas have been scoured to bedrock. The mouth of Snow Creek is located at Discovery Bay.

Red alder was the most common tree species noted in creekside areas. An occasional western red cedar can be found along the sample reach. Big leaf maple and vine maple are also present. Douglas fir and western hemlock are scattered among deciduous trees on slopes above the east bank of the sample reach. Elderberry (*Sambucus* species), osoberry, and salmonberry are abundant shrubs.

SEABECK CREEK

Upstream drainage basin area for the original Seabeck Creek sample reach was 2.2 square miles. The site was changed to a point one mile downstream from the original location in May 1991. A reference site change was necessary when surface flow ceased and intergravel flow persisted. Intergravel stream flow during the spring was also observed at the Bingham Creek reference site. The new reference reach is just upstream from Seabeck Creek's mouth at Seabeck Bay. This change more than doubled the upstream drainage basin area of the reference site. Highest elevations within this basin are 540 feet above mean sea level. The original sample reach was located at 120 feet elevation while the new location is approximately at sea level. Current uses include minimial residential development, grazing, and forest practice activities.

Stream substrate was cobble, gravel, and sand. Water was clear, but with a slight brown tint indicating the presence of naturally occurring organic acids. Algal growth was noted on the stream substrate during the May site visit. Large diameter woody debris was absent from the sample reach.

Tree species along the creek include western red cedar to three feet in diameter at breast height, Douglas fir, and red alder. Shrubby plants include salmonberry, thimbleberry (*Rubus* *parviflorus*), osoberry, cascara (*Rhamnus purshiana*), and vine maple. Herbs include horsetail (*Equisetum* species), ladyfem (*Athyrium filix-femina*), buttercup, and non-native species.

DEWATTO RIVER

Drainage basin area upstream of the Dewatto River sample reach is 5.5 square miles. The sample reach is located at 180 feet above mean sea level and the highest points within the basin exceed 400 feet elevation. Basin uses include historical forest practices and minimal residential development. Dewatto River enters the lower south end of Hood Canal.

Stream substrate within the sample reach is primarily gravel and sand. Water is tea colored. Large organic debris is present within and along the river. The river is heavily shaded by adjacent deciduous trees and shrubs. Evidence of recent beaver activity within the sample reach was found during the August site visit.

Vegetation along slopes above the eastern side of the sample reach was dominated by moderately sized big-leaf maples. Red alder and black cottonwood were found near the river. Scattered second growth western red cedar and western hemlock were noted as well. The tall shrub layer along the sample reach consists of a particularly dense coverage of vine maple. Other shrubby species include: salmonberry, devil's club ((*Oplopanax horidum*), ninebark, salal, and evergreen huckleberry (*Vuccinium ovatum*). Herbaceous species include: ladyfem, bleeding heart, and pig-a-back plant. The distribution of original growth stumps and downed wood within and along the sample reach indicates this sites vegetation was historically dominated by large diameter western red cedar as was most of the Puget Lowland ecoregion.

TAHUYA RIVER

The Tahuya River sample reach is located on Department of Natural Resources (DNR) land at 400 feet elevation above mean sea level. Upstream drainage basin area is 8 square miles and includes Panther and Tahuya Lakes. The highest points within the basin are near 1600 feet elevation at Green Mountain and Gold Mountain. The Tahuya River empties into the south end of Hood Canal.

Stream substrate is primarily cobble, gravel, and sand. Large amounts of deciduous leafy debris are also present within the stream. Portions of the sample reach are overhung by dense deciduous shrubs, especially ninebark. Water was clear, but tea colored during the May site visit. Large organic debris is present in small quantities within the sample reach.

Tree species include second growth Douglas fir and western hemlock in upland areas and western red cedar along the river. The largest conifers approached 2 feet diameter at breast height. Red alder was also commonly encountered. Close to the river, shrubby plants encountered include: ocean spray (*Holodiscus discolor)*, spirea (*Spirea* species), devil's club, ninebark, and salmonberry. Snowberry (*Symphoricarpos* species), salal, oregon grape, baldhip rose, cascara, red huckleberry, evergreen huckleberry, and twinflower *(Linnaeu borealis)* were found in upland areas. Herbaceous species include: ladyfem, brakefern *(Pteridium aquilinum*), vanillaleaf (*Achlys triphylla*) , and fragrant bedstraw (*Galium triflorum*).

TOBOTON CREEK

The Toboton Creek sample reach is 460 feet above mean sea level. Upstream basin area is 2.2 square miles. The highest point in the basin is 800 feet elevation about three miles upstream of the sample reach. Toboton Creek originates from springs, a likely source being nearby Clear Lake. Present basin uses include minimal residential development and some nearby recreation.

Typical stream substrate within the sample reach includes moss covered cobbles, gravel, and sand. Water is slightly tea colored. Large organic debris is present in the creek. Shrubs close over portions of the channel and, in combination with overstory trees, provide a high degree of stream shading.

Overstory of the creekside areas is dominated by red alder and western red cedar. Douglas fir and pacific yew (*Taxus brevifolia*) are present as well. Common shrubs include Oregon grape, ninebark, ocean spray, elderberry, devil's club, salmonberry, thimbleberry, osobeny, and snowberry. Herbs include swordfem, ladies-fern, nettles, skunk cabbage *(Lysichitun americanum*), fragrant bedstraw, and grasses.

Cascades Ecoregion Reference Sites

HEDRICK CREEK

Hedrick Creek lies northwest of Mt. Baker in the Mt. Baker-Snoqualmie National Forest and is one of a series of steep, narrow creek basins bisecting the northeast-facing slopes of Slide Mountain. The sampling station's elevation is 1,000 feet above mean sea level. The drainage basin area upstream is approximately 2 square miles. Two miles upstream from the sampling site, Hedrick Creek reaches the highest point of the basin at an elevation of 4,900 feet. The creek enters the North Fork of the Nooksack River a short distance downstream from the sample reach.

Hedrick Creek is the nortbemmost Cascade reference stream evaluated in this pilot project. Stream substrate is primarily cobbles and boulders. Destabilized banks, loss of streamside vegetation, and characteristic mountain stream channel revisions resulted from winter storm runoff in Hedrick Creek prior to the January 1991 surface water sampling. Portions of the slopes along the lower end of the sample reach were undercut, exposing a 25-foot denuded bank on the east side of the creek. Recently-fallen trees initially lay over the channel at the midpoint of the sample reach, but were removed immediately above the wetted channel during the spring.

Upland areas near the Hedrick Creek site contain closed canopy second growth western hemlock and Douglas fir forests with dominants 1-2 feet in diameter. Decidious tree species common in the vicinity include red alder, big-leaf maple, and willows (*Salix* sp.). Vine maple as well as salmonberry and devil's club in low areas were noted in the shrub layer near the creek. Herbs include lady-fern, sword-fern, and pig-a-back-plant.

GREENWATER RIVER

The headwaters of the Greenwater River originate in mountainous slopes west of the Pacific Cascade Crest in the vicinity of Naches Pass (4,900 feet elevation). The sample reach on the Greenwater river is located at around 2,300 feet elevation and nine miles downstream from the river's origin. Drainage basin area upstream of the sampling site is 52 square miles. This basin is located within the Mt. Baker-Snoqualmie National Forest. Minor impacts from riverside car campers were noted downstream from the sample reach this spring and include: abandoned trash, multiple fire pits, minor streamside alterations, and vegetation disturbance. Land uses within this basin include recreation and forestry. The Greenwater River is part of the Puyallup River drainage.

River substrate is primarily boulder and cobble within the sample reach. River banks are lined with deciduous trees of moderate height. A paved mainline forest road runs along lower slopes above the south bank of the sample reach. Slopes above the north river bank are covered with large conifers. A few large stumps with springboard notches were noted along the rivers edge. It is likely that more of the river was shaded by overhead canopy historically. The deciduous riparian areas show signs of seasonal inundation. However, the river channel is well stabilized in this reach with a narrow flood plain. During low flows at the August site visit, attached green filamentous algae were noted.

Tree species in the riparian areas include red alder, willow species, and an occasional large black cottonwood. Currents (*Ribes* species), vanilla leaf, coltsfoot (*Petasites* species), and Siberian miner's lettuce were also found here. Slopes above the north side of the river contain large Douglas fir, silver fir (*Abies amabilis*), western hemlock, and moderately sized western red cedar. South of the river, between the riparian area and the road, a stand of Douglas fir, Western hemlock, Western red cedar, Pacific yew, grand fir (*Abies grads),* and vine maple are regenerating.

AMERICAN RIVER

The American River sample reach is approximately 2,950 feet above mean sea level and located 20 miles downstream from the rivers headwaters. The highest points within the basin exceed 6,500 feet elevation in the vicinity of Chinook Pass. Upstream of the sample reach, the American River watershed covers 79 square miles. Much of this drainage is within two USFS wilderness areas, although the river corridor itself is not. This watershed originates along the eastern edge of the Cascade Crest and is part of the Yakima River drainage.

River substrate is boulder and cobble. Banks of the sample reach are stable and contain deciduous shrub thickets in places. Moderate shading of the reach is provided by adjacent conifers. A partially stabilized cobble and boulder island is located at the upper end of the sample reach. Human influences of note along the sample reach include a paved road parallelling the river on the north side. A USGS gauging station is located at the base of the sample reach. River water was cloudy during August 1991. An identifiable layer of silt had been deposited in pools and along channel edges prior to our August site visit. Five miles upstream of the reference reach the river water was clear during the same site visit in August 1991 .

Douglas fir, grand fir, and Ponderosa pine are common in the upland forests along the river reach. Oregon grape, Oregon boxwood (*Pachystima myrsinites*), and snowberry shrubs are common in forested areas. Calypso orchids (*Calypso bulbosa*) were in bloom during the May site visit. A few black cottonwoods are scattered closer to the river. Red-osier dogwood (*Cornus stolonifera*) and alder provide much of the shrub cover along the river. Knapweed (*Centaurea* species), monkey-flowers (*Mimulus* species), lupines (*Lupinus* species), grasses, and other herbs were present in open areas.

ENTIAT RIVER

The Entiat River valley is oriented northwest to southeast. It is bordered by the Entiat Mountains on the south and the Chelan Mountains to the north. High points within the watershed are well over 6,500 feet above mean sea level. The sample reach is at 1,950 feet elevation. Upstream basin area is 158 square miles. ‘The river originates 24 miles above the sample reach and empties into the Columbia River about 28 miles downstream.

Slopes along the sample reach include a patchwork of bare rock, young post-fire reproduction, and open pine forest. These areas had been burned over within the last several years as a result of a naturally occurring forest fire. Patches of dead standing trees are visible on upper slopes. A recently cut Ponderosa pine stump has a diameter of 2 feet and shows 110 annual rings. River substrate is primarily boulder, cobble, and gravel. Kick net samples contain a coarse white quartz sand.

Ponderosa pine is the predominant upland tree species in the vicinity of the sample reach. However, Douglas fir saplings are present in moderate numbers. Riparian areas contain black cottonwood and willows. Shrubs include baldhip rose, *Ceanothus* species, and Oregon box. Common herbs include lupine and yarrow (*Achillea* species).

TRAPPERCREEK

The Trapper Creek sample reach and its entire upstream drainage basin are located within U.S. Forest Service-designated wilderness area. Drainage area upstream of the sample reach is 7 square miles. The sample reach is approximately 1,800 feet above mean sea level. The steep upper portions of this drainage exceed 3,900 feet elevation within 3 miles of the reference site. This area appears to be used for only low-impact recreational activities at present. A few old cut stumps were noted along the western bank, but in most cases the logs had not been removed and have rotted on site. Trapper Creek is a tributary to the Wind River.

Creek substrate is primarily boulder and gravel. Streamside rocks are moss-covered. Large organic debris of varied decay class, including cedar logs greater than 6 feet in diameter, are present in and along the stream. This is the only reference stream found for this project which is currently recruiting debris logs with diameters greater than 2 to 3 feet. Although streambanks may be seasonally inundated, there is no evidence of recent bank failure or stream course changes.

Trees found along the sample reach include: Douglas fir and western red cedar frequently in excess of 6 feet diameter at breast height (DBH); western hemlock often greater than 4 feet DBH; and big-leaf maple. No fire scars were seen. Small red alders dominate narrow open areas along the stream. Where the forest canopy has been opened by windthrow, western hemlock appears to dominate regeneration. Shrubs along the sample reach include: vine maple, salmonberry, red huckleberry, and devil's club. Herbaceous species along the sample reach include: Trillium (*Trillium ovatum*), swordfem, brake fern, maidenhair fern (*Adiantum pedatum*), laclyfem, vanilla leaf, bleeding heart, and violet (Viola species).

MIDDLE FORK TEANAWAY RIVER

The Middle Fork of the Teanaway River drains a 26 square mile area upstream of the sample reach. The sample site is 2,600 feet elevation above mean sea level and highest elevations within the basin exceed 5,900 feet. The Middle Fork of the Teanaway originates about 9 miles upstream of the sample reach. Most of this basin is within the Wenatchee National Forest, however, portions checkered are with private forest lands.

Substantial changes in the river course occurred last winter just upstream from the sample reach. Bare dirt and clay banks were exposed where the river cut new channels. Upland conifers up to 2 feet in diameter fell into the river and large amounts of gravel and cobble were deposited within the sample reach. Spring benthic sampling took place in June, as the river was too high to sample during the May visit. Water was clear during the June visit. The August site visit showed very low flows and a newly deposited layer of fine silt on the stream substrate.

Common upland tree species found along the sample reach include grand fir, western hemlock, and Ponderosa pine. Dominants are 1-2 feet in diameter. Black cottonwood, willows, and alders occur along the river. Shrubs noted include: vine maple, oregon boxwood, bald-hip rose, and red-osier dogwood. Herbaceous species include starflower (*Trientalis latifolia*) and monkey-flowers.

Columbia Basin Ecoreeion Reference Sites

NANEUM CREEK

The Naneum Creek reference reach is located on private timberlands near 2,600 feet above mean sea level. The highest points within the basin exceed 5,900 feet elevation approximately 13 miles upstream Drainage basin area upstream of the sample reach is 67 square miles. Creekside areas are fenced leaving an ungrazed riparian buffer, but the uplands within this basin are grazed by cattle. Naneum Creek is a tributary of the Yakima River.

Stream substrate within the sample reach is composed of moderately embedded cobble and gravel. Water is typically clear. Variation in stream flow is partially moderated by water impounded behind a 200 foot long beaver dam just upstream from the sample reach. Beaver dam construction may be a regular occurrence in streams draining the east side Cascades into the Columbia Basin. Partial shading of the sample reach results from the upper, open deciduous canopy along the creek. Minor washouts as well as gravel deposition and seasonal inundation have occurred along banks within the reference reach. Occasional pieces of large organic debris can be found in and along the creek.

Upland areas are composed of open Ponderosa pine forests with sagebrush (*Artemisia* species) and bunchgrass understory. Alder and black cottonwood are scattered along the creek. Red-osier dogwood is dense and very common along the creek border. Other common shrubby species include: willow species, snowberry, ninebark, ocean-spray, blue elderberry (*Sambucus cerulea*), chokecherry (*Prunus virginiana*), and rarely oregon grape. Herbaceous species noted include: iris (*Iris missouriensis*), *sedges* (*Carex* species) and knapweed.

UMTANUM CREEK

The Umtanum Creek sample reach is located within the LT Murray Wildlife area. The sample reach is about 1,600 feet above mean sea level. Upstream basin area is 52 square miles and the highest points within the drainage are about 3,900 feet in elevation. Umtanum Creek's valley is oriented west to east between Manastash Ridge to the north and Umtanum Ridge to the south. Umtanum Creek originates from a series of springs approximately 15 miles upstream from the sample site. A short distance downstream from the sample reach, Umtanum Creek empties into the Yakima River.

Streamside vegetation within the sample reach is dominated by willow species which provide a high degree of shading to the stream. Alder and cottonwood are present in the riparian area as well. The creek substrate is cobble and gravel interspersed with decomposed organics. There are no signs of recent erosion or channel changes within the sample reach. Streamflow is relatively constant year-round. Large organic debris is not found within this sample reach.

Upland vegetation becomes sparse and the most, noticeable plants are sagebrush and knapweed. Cactus (*Opuntia* species) were in bloom during the June visit. Steeper portions of the valley walls north of the stream are talus slopes. South of the stream, sagebrush, knapweed, and bunchgrass cover areas between basalt cliffs.

LITTLE KLICKITAT RIVER

The Little Klickitat River sample reach is located along Highway 97 about 1,800 feet above mean sea level. The upstream drainage basin area is 52 square miles and includes the southern slopes of the Simcoe Mountains. Highest elevations within the drainage exceed 4,600 feet in elevation about 10 miles north of the reference reach. Land uses within the basin include dryland farming and grazing. Streamside fencing provides intact riparian zone vegetation. The Little Klickitat River is a tributary of the Klickitat River.

Substrate within the sample site includes cobbles and leafy organic debris. Banks are gently sloping, covered with vegetation, and without signs of recent erosion. Partial shading is provided by riverside trees.

Tree species along the sample reach include alder and willow. Upland areas contain scattered Ponderosa pine. Red-osier dogwood was the most notable shrubby plant species along the stream edge. Herbaceous species include: horsetail, reeds (*Juncus* species), sedges, and grasses.

CUMMINGS CREEK

Cummings Creek is a tributary of the Tucannon River. The sample site is located on Washington Department of Wildlife land at around 2,300 feet in elevation. Cummings Creek extends about 8 miles upstream beyond the reference reach to elevations of near 4,900 feet. It drains a narrow north-by-northwest to south-by-southeast oriented valley. Upstream of the sample reach are 19 square miles of land within the drainage basin. The Blue Mountains and Umatilla National Forest lie to the south.

Streamside vegetation is mostly deciduous and the creek substrate contains noticeable quantities of detrital material. Moss-covered cobble, gravel, and silt are present as well. The stream channel appears stable, without recent signs of erosion. Infrequent grazing activity may occur along this stream reach, although there was little recent evidence of such activity.

Upland areas contain open Ponderosa pine forests with some fire scars. Quaking aspen (*Populus tremuloides*) is found along the creek. Shrubs in the vicinity of the sample reach include red-osier dogwood, ninebark, blue elderberry, snowberry, rose, and alder. Horsetails and grasses grow along the stream riparian zone.

NORTH FORK ASOTIN CREEK

The North Fork Asotin Creek sample reach is located about 2,400 feet above sea level. Upstream from this reference site the creek drains 42 square mile of canyon country between Smoothing Iron Ridge to the south and Bracken Ridge to the north. Higher elevations within this drainage exceed 4900 feet. Lands within this drainage are managed by the Washington Department of Wildlife, Washington Department of Natural Resources, and U.S. Forest Service. This stream is a part of the Snake River drainage.

The southern edge of the sample reach is bounded by highly weathered rock cliffs. The northern creekside areas contain both deciduous and coniferous forest. Stream substrate is cobble and gravel. Leafy organic input to the stream is large.

Ponderosa pine and Douglas fir up to 2 feet in diameter occur in upland areas. Deciduous trees and shrubs include water-birch (*Betula occidentalis*), blue elderberry, rose, and ocean-spray. Sagebrush and grasses provide understory below patches of open coniferous forest in upland areas. A very large thistle (probably *Carduus* sp.) was observed on the access road to the stream reach.

SPRING CREEK

The Spring Creek sample reach is located 1,600 feet above sea level and drains an 18 square mile area. The upstream drainage area reaches elevations of 2800 feet. Much of the upper end of this basin consists of rolling plateaus and buttes. Above the reference reach, Spring Creek changes from a network of grassy swales running across fields at its headwaters to a rock-lined creek in a narrow, forested canyon further downstream. All of the drainage basin was reportedly forested in historic times prior to its present use of dryland farming. Spring Creek is a tributary of the Spokane River.

As the name suggests, this creek originates from springs in its upper reaches. Stream substrate within the reference reach is cobble, boulder, and mud. No large organic debris was found within the reference reach. Deciduous shrubs and tall grasses inhabit portions of the stream riparian area along the reference reach. Rock slides and talus are found on the steep slopes above the road on the north side of the sample reach.

Above a break in slope along the south side of the creek is an open Douglas fir forest. Above the road on the north side of the canyon is an open, mixed forest of Ponderosa pine and Douglas fir. Alders, birch, and quaking aspen are scattered close to the stream. Shrubs noted include: snowberry, thimbleberry, rose, and red-osier dogwood. Herbs include nettles and grasses. Duckweed ***(Lemnaceae*** Family) is growing in slower flowing stream areas.

Appendix E

Benthic Macroinvertebrate Mean Abundance Tables

Fall 1990 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Bingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton creek
ACARI	UNIDENTIFIED	Hydracarina	0.00	0.00	0.00	0.00	0.00	0.00
AMPHIPODA	TALITRIDAE	Hyalella	0.00	.70	0.00	0.00	0.00	0.00
AMPHIPODA	UNIDENTIFIED	Amphipoda	.50	0.00	0.00	0.00	0.00	0.00
ARACHNOIDEA	ARANEAE	Araneae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	1.40	.50	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius	0.00	5.60	0.00	3.40	0.00	0.00
COLEOPTERA	ELMIDAE	Lara	0.00	.70	0.00	0.00	0.00	1.50
COLEOPTERA	ELMIDAE	Optioservus	0.0"	0.00	0.00	0.00	0.00	1.50
COLEOPTERA	ELMIDAE	Stenelmis	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Zaitzevia	0.00	0.00	0.00	0.00	.35	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	0.00	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	0.00	0.00	0.00	0.00	3.75
DIPTERA	ATHERICIDAE	Atherix	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	4.25	4.20	4.25	4.25	.35	3.75
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	.25	0.00	0.00	0.00	0.00	0.00
DIPTERA	DIXIDAE	Dixa	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	.70	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Maruina	0.00	3.50	0.00	.85	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Psychodidae (Pupa)	0.00	.70	0.00	0.00	0.00	0.00
DIPTERA	PTYCHOPTERIDAE	Ptychoptera	0.00	.70	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	.50	0.00	.50	1.70	.35	.75
DIPTERA	TABANIDAE	Tabanus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	0.00	.70	0.00	0.00	0.00	.75
DIPTERA	TIPULIDAE	Dicranota	0.00	1.40	0.00	4.25	1.05	4.50
DIPTERA	TIPULIDAE	Hexatoma	.50	3.50	0.00	.85	1.40	0.00
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	0.00	0.00	3.00
DIPTERA	TIPULIDAE	Tipula	0.00	.70	2.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	immature	0.00	0.00	.25	0.00	0.00	0.00
DIPTERA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	0.00	2.80	.25	24.65	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Dannella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	0.00	0.00	.85	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	0.00	1.40	0.00	5.95	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	10.75	42.00	5.00	2.55	5.95	14.25
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	0.00	0.00	0.00	0.00	0.00	0.00

Note: Seabeck Creek Fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream location. Spring 1991 and S-r 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were tuo-square meters each in substrate area sampled.

Fall 1990 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	gingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	1.25	9.80	0.00	45.05	4.90	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	0.00	10.50	0.00	0.00	1.05	8.25
EPHEMEROPTERA	TRICORYTHIDAE	Tricorythodes	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	ANCYLIDAE	Ferrissia	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PHYSIDAE	Physa	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PLANORBIDAE	Gyraulus	0.00	0.00	0.00	0.00	.35	0.00
GASTROPODA	PLEUROCERIDAE	Juga	0.00	0.00	0.00	0.00	0.00	18.00
HEMIPTERA	UNIDENTIFIED	Hemiptera	0.00	0.00	0.00	0.00	0.00	0.00
ISOPODA	UNIDENTIFIED	Isopoda	0.00	0.00	.25	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	ANISOPTERA	Anisoptera	0.00	0.00	0.00	0.00	0.00	3.75
ODONATA	COENAGRIONIDAE	Argia	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	.75	4.90	9.00	5.95	20.65	49.50
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	0.00	0.00	0.00	1.70	0.00	0.00
OLIGOCHAETA	NAIDIDAE	Naididae	0.00	0.00	0.00	0.00	0.00	0.00
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	0.00	0.00	0.00	2.25
PLECOPTERA	CAPNIIDAE	Unidentified	0.00	.70	0.00	0.00	0.00	0.00
PLECOPTERA	CAPNIIDAE	Utacapnia	0.00	0.00	0.00	6.80	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Alloperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	0.00	23.80	.25	6.80	2.10	3.00
PLECOPTERA	CHLOROPERLIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Utaperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	.50	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Podmosta	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	0.00	2.80	0.00	4.25	0.00	3.00
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	0.00	3.50	0.00	10.20	7.00	.75
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	0.00	9.35	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Hesperoperla	0.00	0.00	0.00	5.10	0.00	0.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	0.00	0.00	5.95	0.00	0.00
PLECOPTERA	PERLODIDAE	Diura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	0.00	0.00	0.00	2.55	0.00	1.50
PLECOPTERA	PERLODIDAE	Kogotus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Osobenus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Perlinodes	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Setvena	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Unidentified	0.00	.70	0.00	0.00	0.00	0.00

Nate: Seabeck Creek Fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream location. Spring 1991 and Summer 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Fall 1990 synaptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Bingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	.70	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Doddsia	2.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	0.00	0.00	0.00	.85	1.75	.75
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	0.00	0.00	0.00	.70	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HELICOPSYCHIDAE	Helicopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	1.40	0.00	0.00	0.00	4.50
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	0.00	0.06	0.00	5.95	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPTILIDAE	Ochrotrichia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Hydatophylax	0.00	.70	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	.70	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Neophylax	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	0.00	0.00	0.00	.a5	0.00	0.00
TRICHOPTERA	PSYCHOMYIIDAE	Psychomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	PSYCHOMYIIDAE	Tinodes	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	0.00	0.00	0.00	2.55	0.00	a.25
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	0.00	3.50	0.00	2.55	0.00	.75

Note: Seabeck Creek Fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream location. Spring 1991 and Summer 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Fall 1990 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
ACARI	UNIDENTIFIED	Hydracarina	0.00	0.00	0.00	0.00	0.00	0.00
AMPHIPODA	TALITRIDAE	Hyalella	0.00	0.00	0.00	0.00	0.00	0.00
AMPHIPODA	UNIDENTIFIED	Amphipoda	0.00	0.00	0.00	0.00	0.00	0.00
ARACHNOIDEA	ARANEAE	Araneae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	.35	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius	0.00	1.40	1.20	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Lara	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	0.00	"35	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Stenelmis	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Zaitzevia	0.00	0.00	0.00	0.00	1.10	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	0.00	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	0.00	0:00	0.00	0.00	0.00
DIPTERA	ATHERICIDAE	Atherix	.50	.35	0.00	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	.50	.70	0.00	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	DIXIDAE	Oixa	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Maruina	0.00	0.00	1.20	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	0.00	.35	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Psychodidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PTYCHOPTERIDAE	Ptychoptera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	9.50	1.40	0.00	.25	1.10	0.00
DIPTERA	TABANIDAE	Tabanus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	1.50	0.00	8.40	0.00	1.10	1.05
DIPTERA	TIPULIDAE	Dicranota	0.00	.70	2.40	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Hexatoma	0.00	0.00	1.20	0.00	1.10	0.00
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Tipula	.50	0.00	0.00	.25	0.00	0.00
DIPTERA	TIPULIDAE	immature	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	2.20	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	32.50	20.65	26.40	.75	6.60	23.10
EPHEMEROPTERA	EPHEMERELLIDAE	Dannella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	.70	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	2.45	4.80	.25	9.90	10.50
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	.50	2.45	3.60	0.00	0.00	1.05
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	0.00	0.00	0.00	1.05
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	2.50	0.00	36.00	0.00	5.50	13.65
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	11.50	17.50	103.20	1.75	140.80	94.50
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	3.50	5.95	0.00	.50	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	12.00	4.55	58.80	2.50	19.80	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	.50	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	TRICORYTHIDAE	Tricorythodes	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	ANCYLIDAE	Ferrissia	0.00	0.00	0.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were tuo-square meters each in substrate area sampled.

fall 1990 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organism/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
GASTROPODA	PHYSIDAE	Physa	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PLANORBIDAE	Gyraulus	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PLEUROCERIDAE	Juga	0.00	0.00	0.00	0.00	0.00	0.00
HEMIPTERA	UNIDENTIFIED	Hemiptera	0.00	0.00	0.00	0.00	0.00	0.00
ISOPODA	UNIDENTIFIED	Isopoda	0.00	0.00	0.00	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	ANISOPTERA	Anisoptera	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	COENAGRIONIDAE	Argia	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	8.50	2.45	0.00	0.00	1.10	10.50
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	NAIDIDAE	Naididae	0.00	0.00	0.00	0.00	0.00	0.00
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CAPNIIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CAPNIIDAE	Utacapnia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Alloperla	0.00	.70	0.00	0.00	1.10	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	0.00	0.00	2.10
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	2.10
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	10.00	2.10	16.80	1.50	18.70	43.05
PLECOPTERA	CHLOROPERLIDAE	Unidentified	.50	.35	0.00	0.00	1.10	0.00
PLECOPTERA	CHLOROPERLIDAE	Utaperla	0.00	0.00	0.00	0.00	0.00	1.05
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.00	0.00	0.00	.50	0.00	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Podmosta	0.00	0.00	0.00	0.00	0.00	1.05
PLECOPTERA	NEMOURIDAE	Zapada	1.00	0.00	0.00	0.00	3.30	3.15
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	1.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	1.20	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.00	0.00	0.00	0.00	0.00	10.50
PLECOPTERA	PERLIDAE	Hesperoperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	0.00	3.60	0.00	1.10	0.00
PLECOPTERA	PERLODIDAE	Diura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	0.00	.70	4.80	0.00	1.10	1.05
PLECOPTERA	PERLODIDAE	Kogotus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Osobenus	.50	.70	0.00	0.00	4.40	0.00
PLECOPTERA	PERLODIDAE	Perlinodes	.50	0.00	0.00	0.00	1.10	0.00
PLECOPTERA	PERLODIDAE	Setvena	0.00	.35	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	.50	0.00	22.80	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	0.00	0.00	0.00	0.00	0.00	1.05
PLECOPTERA	TAENIOPTERYGIDAE	Doddsia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	2.50	0.00	0.00	15.00	1.10	1.05
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	1.00	.70	4.80	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	.50	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	0.00	0.00	0.00	1.10	4.20
TRICHOPTERA	HELICOPSYCHIDAE	Helicopsyche	0.00	0.00	0.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Fall 1990 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	1.00	1.40	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	1.05	0.00	0.00	9.90	2.10
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	0.00	0.00	15.60	0.00	0.00	'0.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	.25	0.00	2.10
TRICHOPTERA	HYDROPTILIDAE	Ochrotrichia	0.00	.35	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	4.20
TRICHOPTERA	LIMNEPHILIDAE	Hydatophylax	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	0.00	0.00	1.05
TRICHOPTERA	LIMNEPHILIDAE	Neophylax	1.00	0.00	0.00	0.00	6.60	0.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	PSYCHOMYIIDAE	Psychomyia	0.00	0.00	0.00	0.00	0.00	1.05
TRICHOPTERA	PSYCHOMYIIDAE	Tinodes	.50	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	.50	.35	4.80	.25	2.20	1.05
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	1.50	.70	0.00	.50	0.00	9.45

Nate: Mean density of taxa were calculated from two replicate transect collections that were tuo-square meters each in substrate area sampled.

Fall 1990 Synoptic Taxonomic List: Columbia Basin Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring Creek	Umtanum Creek
ACARI	UNIDENTIFIED	Hydracarina	0.00	.60	0.00	0.00	0.00	0.00
AMPHIPODA	TALITRIDAE	Hyalella	0.00	0.00	0.00	0.00	.80	0.00
AMPHIPODA	UNIDENTIFIED	Amphipoda	0.00	0.00	0.00	0.00	0.00	0.00
ARACHNOIDEA	ARANEAE	Araneae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius	0.00	1.20	0.00	0.00	0.00	3.00
COLEOPTERA	ELMIDAE	Lara	0.00	0.00	0.00	1.20	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	3.00	0.00	22.80	28.80	17.60	.75
COLEOPTERA	ELMIDAE	Stenelmis	1.00	.60	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Zaitzevia	0.00	0.00	0.00	2.40	0.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	4.20	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	.60	0.00	0.00	0.00	2.25
DIPTERA	ATHERICIDAE	Atherix	0.00	0.00	6.65	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	18.00	6.60	9.50	4.80	12.80	9.00
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	DIXIDAE	Dixa	0.00	0.00	0.00	0.00	0.00	.75
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Maruina	3.00	0.00	0.00	3.60	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Psychodidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PTYCHOPTERIDAE	Ptychoptera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	7.00	0.00	9.50	2.40	1.60	29.25
DIPTERA	TABANIDAE	Tabanus	0.00	.60	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	3.00	0.00	2.85	1.20	5.60	10.50
DIPTERA	TIPULIDAE	Dicranota	1.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Hexatoma	0.00	20.40	0.00	6.00	0.00	0.00
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Tipula	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	immature	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	16.00	1.80	78.85	60.06	12.00	27.00
EPHEMEROPTERA	EPHEMERELLIDAE	Dannella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	0.00	0.00	1.90	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	0.00	0.00	.95	45.60	9.60	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	47.00	0.00	.95	34.80	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	23.00	.60	0.00	7.20	17.60	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	2.00	2.40	0.00	1.20	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	0.00	4.80	13.30	2.40	0.00	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	13.00	.60	0.00	2.40	0.00	45.75
EPHEMEROPTERA	TRICORYTHIDAE	Tricorythodes	0.00	3.00	0.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Fall 1990 Synoptic Taxonomic List: Columbia Basin Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring Creek	Umtanum Creek
GASTROPODA	ANCYLIDAE	Ferrissia	0.00	0.00	.95	0.00	0.00	0.00
GASTROPODA	PHYSIDAE	Physa	0.00	0.00	0.00	0.00	17.60	0.00
GASTROPODA	PLANORBIDAE	Gyraulus	0.00	0.00	0.00	0.00	1.60	0.00
GASTROPODA	PLEUROCERIDAE	Juga	0.00	0.00	0.00	0.00	0.00	0.00
HEMIPTERA	UNIDENTIFIED	Hemiptera	0.00	0.00	0.00	0.00	0.00	0.00
ISOPODA	UNIDENTIFIED	Isopoda	0.00	0.00	0.00	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	2.40	2.25
ODONATA	ANISOPTERA	Anisoptera	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	COENAGRIONIDAE	Argia	0.00	1.80	0.00	0.00	0.00	2.25
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	18.00	3.00	2.85	1.20	2.40	0.00
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	1.00	1.20	0.00	0.00	63.20	0.00
OLIGOCHAETA	NAIDIDAE	Naididae	0.00	0.00	0.00	0.00	0.00	3.00
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	1.90	2.40	0.00	0.00
PLECOPTERA	CAPNIIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CAPNIIDAE	Utacapnia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	ALloperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	4.00	27.00	0.00	15.60	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Unidentified	1.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Utaperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	2.00	3.60	1.90	1.20	0.00	3.75
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	1.20	0.00	0.00
PLECOPTERA	NEMOURIDAE	Podmosta	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	4.00	.60	0.00	3.60	1.60	7.50
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	1.00	16.80	0.00	0.00	0.00	1.50
PLECOPTERA	PERLIDAE	Claassenia	4.00	0.00	1.90	6.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.00	0.00	0.00	3.60	0.00	0.00
PLECOPTERA	PERLIDAE	Hesperoperla	9.00	9.60	2.85	1.20	0.00	7.50
PLECOPTERA	PERLODIDAE	Cultus	5.00	3.60	0.00	6.00	0.00	4.50
PLECOPTERA	PERLODIDAE	Diura	1.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	1.00	0.00	0.00	1.20	4.00	1.50
PLECOPTERA	PERLODIDAE	Kogotus	2.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Osobenus	2.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Perlinodes	5.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Setvena	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	2.00	0.00	0.00	1.20	0.00	0.00
PLECOPTERA	PERLODIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	0.00	.95	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	8.00	0.00	22.80	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Doddsia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	9.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	0.00	0.00	64.60	1.20	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	0.00	0.00	4.80	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Fail 1990 Synoptic Taxonomic List: Columbia Basin Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring Creek	Umtanum Creek
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	0.00	5.70	0.00	0.00	0.00
TRICHOPTERA	HELICOPSYCHIDAE	Helicopsyche	0.00	1.80	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	2.00	0.00	0.00	4.80	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	17.40	0.00	0.00	0.00	7.50
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	3.00	0.00	12.35	15.60	.80	48.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPTILIDAE	Ochrotrichia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Hydatophylax	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Neophylax	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	16.00	0.60	0.00	0.00	0.00	2.25
TRICHOPTERA	PSYCHOMYIIDAE	Psychomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	PSYCHOMYIIDAE	Tinodes	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	6.00	0.00	.95	1.20	.80	1.50
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	0.00	0.00	0.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Winter 1991 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of organisms/Square Meter)

Order	Family	Genus/Species	Bingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
ACARI	UNIDENTIFIED	Hydracarina	0.00	1.75	0.00	0.00	0.00	1.60
AMPHIPODA	TALITRIDAE	Hyalella	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	0.00	0.00	5.40	0.00	0.00
COLEOPTERA	ELMIDAE	Lara	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	0.00	0.00	0.00	1.35	5.40	0.00
COLEOPTERA	ELMIDAE	Stenelmis (Adult)	0.00	1.75	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Zaitzevia	0.00	7.00	0.00	0.00	2.70	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	PTILODACTYLIDAE	Ptilodactylidae	0.00	0.00	.25	1.35	0.00	0.00
COLLEMBOLA	UNIDENTIFIED	Collembola	0.00	0.00	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	0.00	0.00	0.00	1.35	3.20
DIPTERA	ATHERICIDAE	Atherix	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala	0.00	0.00	0.00	1.35	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Philorus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	5.25	0.00	1.35	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	1.50	42.00	1.25	6.75	39.15	59.20
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	0.00	1.75	0.00	0.00	0.00	6.40
DIPTERA	EMPIDIDAE	Chelifera	0.00	0.00	0.00	0.00	1.35	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	0.00	31.50	.25	0.00	22.95	11.20
DIPTERA	SIMULIIDAE	Simuliidae(Pupa)	0.00	0.00	0.00	0.00	1.35	0.00
DIPTERA	TABANIDAE	Chrysops	0.00	0.00	0.00	0.00	0.00	1.60
DIPTERA	TABANIDAE	Tabanus	0.00	0.00	0.00	0.00	1.35	0.00
DIPTERA	TIPULIDAE	Antocha	0.00	0.00	0.00	0.00	0.00	4.80
DIPTERA	TIPULIDAE	Dicranota	0.00	0.00	0.00	0.00	0.00	6.40
DIPTERA	TIPULIDAE	Hexatoma	.25	43.75	.25	2.70	20.25	11.20
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Molophilus	.75	0.00	.25	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	0.00	15.75	0.00	68.85	4.05	24.00
EPHEMEROPTERA	EPHEMERELLIDAE	Caudatella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	0.00	0.00	5.40	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	0.00	1.75	0.00	1.35	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	0.00	0.00	0.00	8.10	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	11.25	245.00	0.00	98.55	27.00	124.80
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	0.00	7.00	0.00	4.05	4.05	3.20
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	.50	0.00	0.00	33.75	24.30	0.00

Note: Seabeck Creek Fall 1990 and Winter 1991 benfhic macroinvertebrate samples were collected at an upstream Location. Spring 1991 and Sumner 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Winter 1991 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Bingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	0.00	3.50	0.00	2.70	1.35	49.60
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	0.00	7.00	0.00	0.00	0.00	0.00
GASTROPODA	PLEUROCERIDAE	Juga	0.00	0.00	0.00	0.00	0.00	4.80
ISOPODA	UNIDENTIFIED	Isopoda	.50	0.00	0.00	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	COENAGRIONIDAE	Argia	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	GOMPHIDAE	Gomphus	0.00	0.00	0.00	0.00	0.00	4.80
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	1.00	21.00	1.00	25.65	55.35	32.00
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	0.00	0.00	5.40	0.00
PLECOPTERA	CHLOROPERLIDAE	Cultus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	1.35	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Paraperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	0.00	14.00	0.00	2.70	2.70	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	.50	0.00	0.00	5.40	1.35	4.80
PLECOPTERA	NEMOURIDAE	Malenka	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	.25	0.00	.25	0.00	1.35	9.60
PLECOPTERA	NEMOURIDAE	Zapada	0.00	1.75	0.00	0.00	0.00	1.60
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	0.00	10.50	0.00	10.80	20.25	6.40
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Hesperoperla	0.00	15.75	0.00	10.80	0.00	3.20
PLECOPTERA	PERLODIDAE	Cultus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Doroneuria	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	.25	0.00	0.00	0.00	0.00	11.20
PLECOPTERA	PERLODIDAE	Perlinodes	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	0.00	0.00	0.00	0.00	1.60
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	.25	0.00	0.00	5.40	48.60	6.40
TRICHOPTERA	BRACHYCENTRIDAE	Amiocentrus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	0.00	0.00	0.00	0.00	1.60
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	1.75	0.00	0.00	0.00	1.60
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	0.00	0.00	0.00	0.00	9.60
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	0.00	0.00	0.00	5.40	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Pedomoecus	0.00	0.00	0.00	0.00	0.00	0.00

Note: Seabeck Creek Fall 1990 and Winter '1991 benthic macroinvertebrate samples were collected at an upstream Location. Spring 1991 and Summer 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Winter 1991 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of organisms/Square Meter)

Order	Family	Genus/Species	Bingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	0.00	5.25	0.00	9.45	1.35	3.20
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	0.00	0.00	0.00	0.00	8.10	25.60
TRICLADIDA	PLANARIIDAE	Planariidae	0.00	0.00	0.00	0.00	0.00	0.00

Note: Seabeck Creek Fail 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream location. Spring 1991 and Summer 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Winter 1991 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
ACARI	UNIDENTIFIED	Hydracarina	0.00	1.25	0.00	0.00	0.00	0.00
AMPHIPODA	TALITRIDAE	Hyalella	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Lara	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	0.00	1.25	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Stenelmis (Adult)	0.00	0.00	0.00	Cl.00	0.00	0.00
COLEOPTERA	ELMIDAE	Zaitzevia	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	0.00	0.00	.90	0.00	0.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	PTILODACTYLIDAE	Ptilodactylidae	0.00	0.00	0.00	0.00	0.00	0.00
COLLEMBOLA	UNIDENTIFIED	Collembola	0.00	0.00	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	ATHERICIDAE	Atherix	0.00	7.50	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Philorus	0.00	0.00	.90	1.50	0.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	0.00	41.25	2.70	0.00	2.00	2.70
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Chelifera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	0.00	0.00	.90	1.50	2.00	1.35
DIPTERA	SIMULIIDAE	Simuliidae(Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TABANIDAE	Chrysops	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TABANIDAE	Tabanus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	0.00	0.00	0.00	0.00	4.00	0.00
DIPTERA	TIPULIDAE	Dicranota	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Hexatoma	0.00	1.25	2.70	0.00	0.00	4.05
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	.90	0.00	2.00	0.00
DIPTERA	TIPULIDAE	Molophilus	0.00	0.00	0.00	0.00	0.00	II.00
DIPTERA	TIPULIDAE	Unidentified	0.00	1.25	0.00	0.00	2.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	66.50	128.75	62.10	18.00	64.00	29.70
EPHEMEROPTERA	EPHEMERELLIDAE	Caudatella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	6.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	.95	11.25	2.70	1.50	8.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	0.00	1.25	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	0.00	0.00	5.40	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	.95	3.75	.90	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	4.75	6.25	41.40	0.00	0.00	5.40
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	48.45	78.75	49.50	12.00	266.00	122.85
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	1.90	16.25	9.90	1.50	12.00	17.55
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	25.65	10.00	2.70	15.00	16.00	1.35
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	0.00	1.25	0.00	0.00	0.00	1.35
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	0.00	0.00	0.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Winter 1991 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
GASTROPODA	PLEUROCERIDAE	Juga	0.00	0.00	0.00	0.00	0.00	0.00
ISOPODA	UNIDENTIFIED	Isopoda	0.00	0.00	0.00	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	COENAGRIONIDAE	Argia	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	GOMPHIDAE	Gomphus	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	19.00	12.50	0.00	0.00	18.00	9.45
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Cultus	0.00	1.25	2.70	0.00	16.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	0.00	0.00	1.35
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	2.00	2.70
PLECOPTERA	CHLOROPERLIDAE	Paraperla	0.00	0.00	0.00	0.00	6.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	21.85	3.75'	14.40	1.50	12.00	48.60
PLECOPTERA	LEUCTRIDAE	Perlomyia	1.90	2.50	.90	6.00	2.00	4.05
PLECOPTERA	NEMOURIDAE	Malenka	0.00	0.00	0.00	0.00	0.00	2.70
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	0.00	3.75	0.00	0.00	0.00	6.75
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	6.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	.95	0.00	0.00	0.00	0.00	10.80
PLECOPTERA	PERLIDAE	Hesperoperla	0.00	5.00	1.80	1.50	0.00	0.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	1.25	2.70	0.00	16.00	0.00
PLECOPTERA	PERLODIDAE	Doroneuria	.95	0.00	0.00	0.00	0.00	10.80
PLECOPTERA	PERLODIDAE	Isoperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Perlinodes	.95	0.00	1.80	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	0.00	1.25	0.00	0.00	12.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	0.00	1.25	0.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	5.70	3.75	5.40	307.50	54.00	2.70
TRICHOPTERA	BRACHYCENTRIDAE	Amiocentrus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	.95	6.25	3.60	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	1.25	0.00	0.00	4.00	4.05
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	0.00	7.50	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	0.00	0.00	0.00	0.00	1.35
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	0.00	0.00	9.00	0.00	14.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	0.00	1.25	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	2.50	5.40	0.00	0.00	2.70
TRICHOPTERA	LIMNEPHILIDAE	Pedomoecus	.95	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	0.00	0.00	.90	3.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	8.50	2.50	.90	1.50	6.00	2.70
TRICLADIDA	PLANARIIDAE	Planariidae	0.00	0.00	0.00	0.00	0.00	1.35

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled

Winter 1991 Synaptic Taxonomic List: Columbia Basin Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring Creek	Umtanum Creek
ACARI	UNIDENTIFIED	Hydracarina	0.00	0.00	0.00	0.00	0.00	1.75
AMPHIPODA	TALITRIDAE	Hyalella	0.00	0.00	3.00	0.00	0.00	3.50
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Lara	2.50	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	'12.50	0.00	42.00	0.00	1.60	10.50
COLEOPTERA	ELMIDAE	Stenelmis (Adult)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Zaitzevia	17.5"	0.00	3.00	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	2.75	0.00	0.00	0.00	0.00
COLEOPTERA	PTILODACTYLIDAE	Ptilodactylidae	0.00	0.00	0.00	0.00	0.00	0.00
COLLEMBOLA	UNIDENTIFIED	Collembola	0.00	0.00	0.00	0.00	1.60	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	5.00	0.00	0.00	0.00	0.00	1.75
DIPTERA	ATHERICIDAE	Atherix	0.00	0.00	30.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Philorus	0.00	0.00	3.00	0.00	0.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	30.00	42.35	141.00	162.00	6.40	33.25
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	2.50	1.65	15.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Chelifera	0.0"	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	12.50	0.00	0.00	3.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	10.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	2.50	0.00	57.00	6.00	1.60	31.50
DIPTERA	SIMULIIDAE	Simuliidae(Pupa)	0.00	0.00	3.00	0.00	0.00	0.00
DIPTERA	TABANIDAE	Chrysops	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TABANIDAE	Tabanus	2.50	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	2.50	.55	6.00	9.00	3.20	40.25
DIPTERA	TIPULIDAE	Dicranota	5.00	0.00	a.00	0.00	0.00	3.50
DIPTERA	TIPULIDAE	Hexatoma	0.00	13.20	0.00	6.00	0.00	0.00
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Molophilus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	47.50	4.95	642.00	273.00	52.80	106.75
EPHEMEROPTERA	EPHEMERELLIDAE	Caudatella	0.00	0.00	3.00	3.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	0.00	0.00	9.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	0.00	0.00	3.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	15.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	7.50	1.10	3.00	39.00	73.60	8.75
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	120.00	6.05	0.00	240.00	142.40	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	35.00	2.20'	57.00	15.00	11.20	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	0.00	13.20	78.00	3.00	0.00	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	7.50	1.10	0.00	45.00	0.00	54.25
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	0.00	0.00	0.00	3.00	0.00	1.75

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Winter 1991 Synoptic Taxonomic List: Columbia Basin Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	spring Creek	Umtanum Creek
GASTROPODA	PLEUROCERIDAE	Juga	0.00	0.00	0.00	0.00	0.00	0.00
ISOPODA	UNIDENTIFIED	Isopoda	0.00	0.00	0.00	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	0.00	5.25
ODONATA	COENAGRIONIDAE	Argia	0.00	0.00	0.00	0.00	0.00	1.75
ODONATA	GOMPHIDAE	Gomphus	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	42.50	3.85	24.00	24.00	I1.20	19.25
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	.55	6.00	0.00	0.00	1.75
PLECOPTERA	CHLOROPERLIDAE	Cultus	0.00	0.00	0.00	12.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Paraperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	5.00	5.50	0.00	3.00	0.00	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.00	.55	12.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Malenka	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	2.20	9.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	2.50	0.00	0.00	18.00	3.20	14.00
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	2.5"	12.65	0.00	0.00	0.00	1.75
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	0.00	9.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	7.50	0.00	0.00	0.00	0.00	3.50
PLECOPTERA	PERLIDAE	Hesperoperla	45.00	0.00	18.00	15.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	0.00	0.00	12.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Doroneuria	7.50	0.00	0.00	0.00	0.00	3.50
PLECOPTERA	PERLODIDAE	Isoperla	2.50	1.65	0.00	9.00	0.00	12.25
PLECOPTERA	PERLODIDAE	Perlinodes	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	0.00	0.00	0.00	3.00	1.60	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	0.00	3.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	7.50	0.00	45.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	130.00	0.00	3.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Amiocentrus	0.00	0.00	150.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	0.00	0.00	9.00	1.60	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	0.00	27.00	0.00	1.60	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	2.50	0.00	0.00	3.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	22.50	0.00	0.00	12.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	2.50	6.60	33.00	0.00	25.60	49.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	3.20	0.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	.55	0.00	0.00	0.00	5.25
TRICHOPTERA	LIMNEPHILIDAE	Pedomoecus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	5.00	0.00	12.00	6.00	6.40	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	65.00	0.00	3.00	3.00	0.00	1.75
TRICLADIDA	PLANARIIDAE	Planariidae	0.00	0.00	0.00	0.00	11.20	0.00

Note: Wean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

spring 1991 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Bingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
ACARI	UNIDENTIFIED	Hydracarina	0.00	0.00	0.00	0.00	1.35	0.00
AMPHIPODA	TALITRIDAE	Hyalella	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	4.80	2.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius	0.00	1.20	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius (Adult)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius (Exuvia)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Lara	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	0.00	0.00	1.00	0.00	0.00	1.25
COLEOPTERA	ELMIDAE	Optioservus (Adult)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Stenelmis	0.00	0.00	0.0"	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	0.00	0.00	0.0"	0.00	0.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	0.00	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	1.20	0.00	2.00	1.35	0.00
DIPTERA	ATHERICIDAE	Atherix	0.00	0.00	0.0"	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Agathon	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	2.40	0.00	2.00	1.35	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	29.00	62.40	44.00	28.00	39.15	21.25
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	0.00	1.20	0.00	0.00	0.00	0.00
DIPTERA	DIXIDAE	Dixidae	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Clinocera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	0.00	0.00	2.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	0.00	9.60	0.00	2.00	0.00	5.00
DIPTERA	SIMULIIDAE	Simuliidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TABANIDAE	Tabanus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	0.00	0.00	0.00	2.00	0.00	0.00
DIPTERA	TIPULIDAE	Chelifera	0.00	0.00	0.00	0.00	0.00	2.50
DIPTERA	TIPULIDAE	Dicranota	0.00	0.00	0.00	0.00	0.00	2.50
DIPTERA	TIPULIDAE	Hexatoma	0.00	15.60	8.00	0.00	8.10	6.25
DIPTERA	TIPULIDAE	Limnophila	1 .00	27.60	6.00	0.00	55.35	6.25
DIPTERA	TIPULIDAE	Molophilus	0.00	0.00	2.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Pseudolimnophila	0.00	0.00	0.00	0.00	0.00	1.25
DIPTERA	TIPULIDAE	Unidentified (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	0.00	21.60	23.00	180.00	4.05	30.00
EPHEMEROPTERA	EPHEMERELLIDAE	Attenella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Caudatella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	0.00	0.00	4.00	0.00	0.00

Note: Seabeck Creek Fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream Location. Spring 1991 and Summer 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Spring 1991 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Bingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	1.50	0.00	8.00	20.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	0.00	2.40	3.00	10.00	28.35	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	0.00	27.60	42.00	84.00	1.35	8.75
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	0.00	3.60	13.00	56.00	8.10	2.50
EPHEMEROPTERA	HEPTAGENIIDAE	Ironodes	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	0.00	0.00	0.00	12.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	.50	9.60	19.00	0.00	18.90	33.75
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	0.00	20.40~	4.0"	8.00	8.10	0.00
EPHEMEROPTERA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	ANCYLIDAE	Ferrissia	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PHYSIDAE	Physa	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PLEUROCERIDAE	Jugus	0.00	0.00	0.00	0.00	0.00	6.25
LEPIDOPTERA	PYRALIDAE	Pyralidae	0.00	0.00	0.00	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	0.00	0.00
NEMATODA	UNIDENTIFIED	Unidentified	0.00	0.00	0.0"	0.00	0.00	0.00
NEMATOMORPHA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	ANISOPTERA	Anisoptera	0.00	0.00	0.00	0.00	0.00	1.25
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	2.00	0.00	2.00	12.00	37.80	70.00
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	NAIDIDAE	Naididae	0.00	0.00	0.00	0.00	0.00	0.00
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	0.00	0.00	0.00	5.00
PLECOPTERA	CAPNIIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	61.20	32.00	2.00	22.95	6.25
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Neaviperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.00	0.00	1.00	0.00	0.00	10.00
PLECOPTERA	NEMOURIDAE	Amphinemura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Podmosta	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	.50	2.40	1.00	0.00	1.35	7.50
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	0.00	0.00	1.25
PLECOPTERA	PERLIDAE	Calineuria	0.00	10.80	6.00	6.00	10.80	5.00
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Hesperoperla	0.00	0.00	0.00	18.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	1.00	1.20	2.00	0.00	2.70	1.25

Note: Seabeck Creek Fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream Location. Spring 1991 and Sumner 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Spring 1991 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Bingham Creek	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
PLECOPTERA	PERLODIDAE	Kogotus	0.00	0.00	0.00	0.00	0.00	1.25
PLECOPTERA	PERLODIDAE	Skwala	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Amiocentrus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	0.00	0.00	4.00	0.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	1.20	0.00	4.00	0.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma (Pupa)	0.0"	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	1.20	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	0.00	0.00	0.00	10.00	0.00	1.25
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Dicosmoecus	0.00	0.00	0.00	0.00	1.35	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	1.20	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Limnephilidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Neophylax	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Onocosmoecus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Pedomoecus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	0.00	0.00	0.00	0.00	68.85	21.25
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	0.0"	0.00	0.00	0.00	0.00	1.25
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	0.00	7.20	4.00	28.00	5.40	2.50
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila (Pupa)	0.00	1.20	0.00	0.00	4.05	1.25
TRICHOPTERA	UNIDENTIFIED	Unidentified (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
TRICLADIDA	PLANARIIDAE	Planariidae	0.00	0.00	0.00	0.00	0.00	0.00

Note: Seabeck Creek fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream Location. Spring 1991 and Sumner 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Spring 1991 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
ACARI	UNIDENTIFIED	Hydracarina	3.00	2.20	0.00	0.00	0.00	0.00
AMPHIPODA	TALITRIDAE	Hyalella	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	3.30	0.00	0.00	0.00	4.00
COLEOPTERA	ELMIDAE	Heterlimnius	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius (Adult)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius (Exuvia)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Lara	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	0.00	0.00	0.00	0.00	4.50	4.00
COLEOPTERA	ELMIDAE	Optioservus (Adult)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Stenelmis	0.00	0.00	0.00	0.00	2.25	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	0.00	0.00	0.00	0.00	0.00	2.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	0.00	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	ATHERICIDAE	Atherix	3.00	2.20	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Agathon	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala	0.00	0.00	0.00	1.50	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala (Pupa)	1.50	0.00	0.00	0.00	0.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	1.10	1.35	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	7.50	7.70	6.75	3.00	11.25	14.00
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	0.00	0.00	1.35	0.00	0.00	0.00
DIPTERA	DIXIDAE	Dixidae	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Clinocera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	0.00	2.25	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	0.00	0.00	1.35	0.00	9.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae (Pupa)	0.00	0.00	0.00	0.00	4.50	0.00
DIPTERA	TABANIDAE	Tabanus	0.00	0.00	0.00	0.00	2.25	0.00
DIPTERA	TIPULIDAE	Antocha	1.50	0.00	0.00	0.00	0.00	6.00
DIPTERA	TIPULIDAE	Chelifera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Dicranota	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Hexatoma	0.00	2.20	8.10	3.00	11.25	14.00
DIPTERA	TIPULIDAE	Limnophila	0.00	1.10	0.00	0.00	11.25	0.00
DIPTERA	TIPULIDAE	Molophilus	0.00	6.60	0.00	1.50	0.00	0.00
DIPTERA	TIPULIDAE	Pseudolimnophila	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	106.50	54.70	72.90	103.50	11.25	100.00
EPHEMEROPTERA	EPHEMERELLIDAE	Attenella	7.50	1.10	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Caudatella	0.00	1.10	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	2.25	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	13.50	0.00	2.70	1.50	20.25	4.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	10.50	5.50	6.75	1.50	2.25	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Spring 1991 synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	1.50	7.70	0.00	0.00	9.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	3.30	0.00	0.00	4.50	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	15.00	0.00	12.15	1.50	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	25.50	26.40	91.80	24.00	63.00	112.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	93.00	2.20	48.60	214.50	144.00	106.00
EPHEMEROPTERA	HEPTAGENIIDAE	Ironodes	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	7.50	3.30	2.70	0.00	42.75	6.00
EPHEMEROPTERA	HEPTAGENIIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	0.00	0.00	0.00	0.00	0.00	8.00
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	3.00	5.50	1.35	1.50	0.00	2.00
EPHEMEROPTERA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	ANCYLIDAE	Ferrissia	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PHYSIDAE	Physa	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PLEUROCERIDAE	Jugus	0.00	0.00	0.00	0.00	0.00	0.00
LEPIDOPTERA	PYRALIDAE	Pyralidae	0.00	0.00	0.00	0.00	2.25	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	0.00	0.00
NEMATODA	UNIDENTIFIED	Unidentified	1.50	0.00	0.00	0.00	0.00	0.00
NEMATOMORPHA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	ANISOPTERA	Anisoptera	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	82.50	2.20	24.30	6.00	42.75	52.00
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	NAIDIDAE	Naididae	0.00	0.00	0.00	0.00	0.00	0.00
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CAPNIIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	31.90	25.65	21.00	114.75	84.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	6.00
PLECOPTERA	CHLOROPERLIDAE	Neaviperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	12.00	0.00	0.00	0.00	2.25	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.00	0.00	0.00	1.50	0.00	0.00
PLECOPTERA	NEMOURIDAE	Amphinemura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Podmosta	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	0.00	0.00	1.35	0.00	0.00	0.00
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	3.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	0.00	0.00	0.00	0.00	2.25	18.00
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.00	0.00	0.00	0.00	0.00	4.00
PLECOPTERA	PERLIDAE	Hesperoperla	1.50	0.00	4.05	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	0.00	0.00	9.45	0.00	0.00	30.00
PLECOPTERA	PERLODIDAE	Kogotus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	6.00	12.10	0.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Spring 1991 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
PLECOPTERA	PERLODIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	0.00	0.00	0.00	0.00	2.25	2.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	0.00	0.00	0.00	4.50	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Amiocentrus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	6.00	28.60	2.70	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	2.20	0.00	0.00	0.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	0.00	0.00	0.00	0.00	8.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	0.00	0.00	16.20	0.00	11.25	6.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	4.50	0.00	2.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	1.50	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Dicosmoecus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Limnephilidae (Pupa)	3.00	4.40	0.00	0.00	2.25	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	0.00	0.00	2.00
TRICHOPTERA	LIMNEPHILIDAE	Neophylax	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Onocosmoecus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Pedomoecus	0.00	0.00	2.70	0.00	0.OD	0.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	4.50	1.10	5.40	4.50	4.50	6.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	13.50	7.70	8.10	3.00	6.75	8.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila (Pupa)	1.50	0.00	0.00	1.50	0.00	4.00
TRICHOPTERA	UNIDENTIFIED	Unidentified (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
TRICLADIDA	PLANARIIDAE	Planariidae	3.00	3.30	0.00	0.00	0.00	4.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Spring 1991 Synoptic Taxonomic List: Columbia Basin Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	spring Creek	Umtanum Creek
ACARI	UNIDENTIFIED	Hydracarina	0.00	0.00	0.00	0.00	0.00	0.00
AMPHIPODA	TALITRIDAE	Hyalella	0.00	0.00	0.00	0.00	2.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius	0.00	0.00	0.00	2.40	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius (Adult)	0.00	0.00	6.00	0.00	2.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius (Exuvia)	0.00	0.00	0.00	0.00	4.00	0.00
COLEOPTERA	ELMIDAE	Lara	0.00	0.00	0.00	1.20	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	0.00	1.35	34.00	2.40	0.00	14.00
COLEOPTERA	ELMIDAE	Optioservus (Adult)	0.00	0.00	0.00	0.00	0.00	1.75
COLEOPTERA	ELMIDAE	Stenelmis	12.00	0.00	4.00	1.20	0.00	19.25
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	12.15	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	1.35	0.00	0.00	0.00	5.25
DIPTERA	ATHERICIDAE	Atherix	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Agathon	12.00	0.00	0.00	1.20	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Bibiocephala (Pupa)	0.00	0.00	0.00	0.00	2.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	0.00	0.00	2.40	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	186.00	116.10	34.00	25.20	66.00	175.00
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	12.00	14.85	2.00	2.40	16.00	3.50
DIPTERA	DIXIDAE	Dixidae	0.00	0.00	0.00	0.00	2.00	0.00
DIPTERA	EMPIDIDAE	Clinocera	0.00	8.10	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Pericoma	0.00	0.00	0.00	2.40	0.00	Cl.00
DIPTERA	SIMULIIDAE	Simuliidae	9.00	0.00	0.00	10.80	2.00	3.50
DIPTERA	SIMULIIDAE	Simuliidae (Pupa)	0.00	0.00	0.00	1.20	0.00	0.00
DIPTERA	TABANIDAE	Tabanus	9.00	0.00	2.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	27.00	8.10	32.00	2.40	30.00	3.50
DIPTERA	TIPULIDAE	Chelifera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Dicranota	0.00	0.00	6.00	0.00	0.00	1.75
DIPTERA	TIPULIDAE	Hexatoma	0.00	43.20	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Molophilus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Pseudolimnophila	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified (Pupa)	0.00	6.75	0.00	0.00	2.00	1.75
EPHEMEROPTERA	BAETIDAE	Baetis	114.00	32.40	94.00	57.60	212.00	110.25
EPHEMEROPTERA	EPHEMERELLIDAE	Attenella	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Caudatella	0.00	0.00	8.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	6.00	0.00	20.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	3.00	0.00	4.00	2.40	24.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Spring 1991 Synoptic Taxonomic List: Columbia Basin Stream*

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring Creek	Umtanum Creek
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	0.00	7.20	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	0.00	0.00	0.00	13.20	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	210.00	6.75	6.00	24.00	28.00	1.75
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	0.00	0.00	0.00	3.60	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	90.00	5.40	58.00	22.80	50.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Ironodes	3.00	0.00	0.00	0.00	2.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	0.00	2.70	40.00	7.20	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Unidentified	0.00	0.00	2.00	0.00	0.00	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	30.00	2.70	0.00	22.80	0.00	22.75
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	UNIDENTIFIED	Unidentified	0.00	1.35	0.00	0.00	0.00	0.00
GASTROPODA	ANCYLIDAE	Ferrissia	0.00	0.00	2.00	0.00	0.00	0.00
GASTROPODA	PHYSIDAE	Physa	0.00	0.00	0.00	0.00	2.00	0.00
GASTROPODA	PLEUROCERIDAE	Jugus	0.00	0.00	0.00	0.00	0.00	0.00
LEPIDOPTERA	PYRALIDAE	Pyralidae	0.00	0.00	0.00	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	1.20	0.00	0.00
NEMATODA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
NEMATOMORPHA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	2.00	0.00
ODONATA	ANISOPTERA	Anisoptera	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	21.00	10.80	4.00	6.00	4.00	5.25
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	0.00	4.05	0.00	0.00	4.00	0.00
OLIGOCHAETA	NAIDIDAE	Naididae	3.00	0.00	4.00	18.00	0.00	5.25
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	1.35	6.00	1.20	0.00	0.00
PLECOPTERA	CAPNIIDAE	Unidentified	6.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Neaviperla	0.00	0.00	6.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	3.00	13.50	0.00	3.60	0.00	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.00	0.00	2.00	0.00	0.00	3.50
PLECOPTERA	NEMOURIDAE	Amphinemura	0.00	0.00	0.00	0.00	2.00	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Podmosta	0.00	0.00	0.00	2.40	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	3.00	0.00	0.00	0.00	0.00	17.50
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	15.00	33.75	0.00	0.00	0.00	8.75
PLECOPTERA	PERLIDAE	Claassenia	12.00	8.10	0.00	1.20	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Hesperoperla	30.00	0.00	8.00	8.40	0.00	0.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	2.70	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	0.00	0.00	0.00	4.80	0.00	0.00
PLECOPTERA	PERLODIDAE	Kogotus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	0.00	0.00	0.00	1.20	0.00	0.00
PLECOPTERA	PERLODIDAE	Unidentified	6.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	3.00	0.00	30.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Spring 1991 Synaptic Taxonomic List: Columbia Basin Stream*

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring Creek	Umtanum Creek
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	0.00	0.00	0.00	3.60	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Amiocentrus	0.00	0.00	0.00	2.40	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	0.00	0.00	68.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	2.70	2.00	6.00	8.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	1.35	18.00	1.20	0.00	1.75
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma (Pupa)	0.00	0.00	2.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	3.00	0.00	0.00	6.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	6.75	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	12.00	13.50	10.00	13.20	28.00	8.75
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Dicosmoecus	3.00	2.70	0.00	0.00	0.00	5.25
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Limnephilidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	1.20	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Neophylax	0.00	0.00	8.00	0.00	4.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Onocosmoecus	12.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Pedomoecus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	0.00	0.00	0.00	1.20	0.00	1.75
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	9.00	1.35	12.00	10.80	10.00	1.75
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophiia #2	57.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	UNIDENTIFIED	Unidentified (Pupa)	3.00	0.00	0.00	0.00	0.00	3.50
TRICLADIDA	PLANARIIDAE	Planariidae	0.00	0.00	0.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Summer 1991 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance 'Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
ACARI	UNIDENTIFIED	Hydracarina	2.25	5.00	3.00	14.45	4.00
COLEOPTERA	CHRYSOMELIDAE	Donacia (Adult)	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	DYTISCIDAE	Hydaticus	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	DYTISCIDAE	Hydrovatus	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	2.25	1.00	0.00	4.25	0.00
COLEOPTERA	ELMIDAE	Heterlimnius	2.25	2.00	12.00	2.55	2.00
COLEOPTERA	ELMIDAE	Heterlimnius (Adult)	45.00	2.00	0.00	1.70	0.00
COLEOPTERA	ELMIDAE	Optioservus	0.00	1.00	0.00	0.00	1.00
COLEOPTERA	ELMIDAE	Optioservus (Adult)	2.25	0.00	27.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus (Pupa)	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Stenelmis	0.00	0.00	3.00	0.00	0.00
COLEOPTERA	GYRINIDAE	Gyrinidae	0.00	1.00	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	6.75	1.00	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae (Adult)	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	0.00	0.00	0.00	0.00
COLLEMBOLA	UNIDENTIFIED	Collembola	0.00	0.00	0.00	0.00	3.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	2.25	0.00	0.00	6.80	3.00
DIPTERA	ATHERICIDAE	Atherix	2.25	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Agathon	0.00	0.00	0.00	0.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	0.00	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	81.00	69.00	6.00	49.30	9.00
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	0.00	0.00	0.00	.85	0.00
DIPTERA	EMPIDIDAE	Clinocera	0.00	1.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	3.00	9.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Maruina	0.00	0.00	3.00	0.00	0.00
DIPTERA	PTYCHOPTERIDAE	Ptychoptera	0.00	0.00	0.00	0.00	1.00
DIPTERA	SIMULIIDAE	Simuliidae	29.25	36.00	99.00	1.70	5.00
DIPTERA	SIMULIIDAE	Simuliidae (Pupa)	0.00	0.00	0.00	0.00	0.00
DIPTERA	TABANIDAE	Tabanidae (Pupa)	0.00	0.00	0.00	0.00	0.00
DIPTERA	TABANIDAE	Tabanus	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Dicranota	0.00	1.00	0.00	0.00	2.00
DIPTERA	TIPULIDAE	Hesperoconopa	0.00	5.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Hexatoma	2.25	1.00	3.00	2.55	1.00
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Tipula	0.00	0.00	3.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified (Pupa)	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	45.00	109.00	171.00	11.90	15.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	0.00

Note: Seabeck Creek Fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream Location. Spring 1991 and Summer 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Summer 1991 Synoptic Taxonomic List: Puget Lowland Stream*

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	0.00	84.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	0.00	19.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	0.00	0.00	12.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Timpanoga	0.00	11.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	6.75	13.00	30.00	.85	4.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	24.75	5.00	102.00	14.45	30.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	0.00	0.00	3.00	0.00	1.00
EPHEMEROPTERA	HEPTAGENIIDAE	Heptagenia	0.00	0.00	0.00	1.70	1.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	0.00	0.00	3.00	0.00	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	P. bicornuta	0.00	0.00	0.00	6.80	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	4.50	5.00	0.00	7.65	6.00
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PHYSIDAE	Physa	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PLANORBIDAE	Gyraulus	0.00	0.00	0.00	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	1.00
NEMATODA	UNIDENTIFIED	Unidentified	0.00	0.00	6.00	0.00	2.00
ODONATA	GOMPHIDAE	Octogomphus	0.00	0.00	0.00	0.00	2.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	0.00	1.00	0.00	0.00	2.00
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	0.00	0.00	0.00	6.80	15.00
OLIGOCHAETA	NAIDIDAE	Yaididae	0.00	1.00	0.00	4.25	5.00
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CAPNIIDAE	Capniidae	0.00	0.00	0.00	.85	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Neaviperla	0.00	0.00	18.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	20.25	9.00	36.00	27.20	28.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.00	0.00	0.00	0.00	2.00
PLECOPTERA	NEMOURIDAE	Amphinemura	2.25	0.00	0.00	.85	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	11.25	44.00	45.00	3.40	12.00
PLECOPTERA	PELTOPERLIDAE	Soliperla	0.00	0.00	0.00	0.00	3.00
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	40.50	4.00	27.00	20.40	2.00
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Hesperoperla	99.00	0.00	198.00	26.35	22.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	0.00	0.00	9.00	Cl.00	0.00
PLECOPTERA	PERLODIDAE	Kogotus	0.00	0.00	0.00	0.00	1.00
PLECOPTERA	PERLODIDAE	Perlinodes	0.00	0.00	0.00	0.00	0.00

Note: Seabeck Creek Fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream location. Spring 1991 and Sumner 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were two-square meter* each in substrate area sampled.

Summer 1991 Synoptic Taxonomic List: Puget Lowland Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Dewatto River	Seabeck Creek	Snow Creek	Tahuya River	Toboton Creek
PLECOPTERA	PERLODIDAE	Setvena	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	0.00	19.00	0.00	0.00	4.00
PLECOPTERA	PERLODIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	0.00	0.00	0.00	0.00	1.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	0.00	1.00	0.00	2.55	1.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	1.00	0.00	0.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	4.00	12.00	0.00	1.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma (Pupa)	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	0.00	0.00	24.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	0.00	0.00	1.70	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Hydrapsyche	33.75	0.00	21.00	2.55	12.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	2.25	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Apatania	2.25	1.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Clostoeca	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Dicosmoecus	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisocosmoecus	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	72.00	1.00	3.00	10.20	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	0.00	0.00	3.00	.85	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	6.75	2.00	3.00	5.10	2.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila (Pupa)	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	UNIDENTIFIED	Unidentified (Pupa)	2.25	3.00	18.00	.85	0.00
TRICLADIDA	PLANARIIDAE	Planariidae	0.00	0.00	0.00	.a5	0.00

Note: Seabeck Creek Fall 1990 and Winter 1991 benthic macroinvertebrate samples were collected at an upstream location. Spring 1991 and Summer 1991 macroinvertebrate samples were collected near the mouth of Seabeck Creek.

Mean density of taxa were calculated from two replicate transect collections that were tuo-square meters each in substrate area sampled.

Summer 1991 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
ACARI	UNIDENTIFIED	Hydracarina	2.25	0.00	0.00	0.00	6.00	18.00
COLEOPTERA	CHRYSOMELIDAE	Donacia (Adult)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	DYTISCIDAE	Hydaticus	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	DYTISCIDAE	Hydrovatus	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius	0.00	0.00	0.00	0.00	3.00	24.00
COLEOPTERA	ELHIDAE	Heterlimnius (Adult)	0.00	0.00	0.00	0.00	0.00	21.00
COLEOPTERA	ELMIDAE	Optioservus	0.00	9.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus (Adult)	0.00	0.00	6.00	0.00	3.00	0.00
COLEOPTERA	ELMIDAE	Optioservus (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Stenelmis	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	GYRINIDAE	Gyrinidae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae (Adult)	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	0.00	0.00	0.00	0.00	0.00
COLLEMBOLA	UNIDENTIFIED	Collembola	0.00	0.00	0.00	2.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	ATHERICIDAE	Atherix	0.00	9.00	0.00	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Agatha"	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	36.00	33.75	69.00	174.00	105.00	54.00
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	2.25	0.00	0.00	2.00	33.00	3.00
DIPTERA	EMPIDIDAE	Clinocera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	6.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	0.00	0.00	0.00	0.00	0.00	6.00
DIPTERA	PSYCHODIDAE	Maruina	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PTYCHOPTERIDAE	Ptychoptera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	0.00	0.00	6.00	2.00	0.00	15.00
DIPTERA	SIMULIIDAE	Simuliidae (Pupa)	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TABANIDAE	Tabanidae (Pupa)	0.00	0.00	0.00	0.0"	0.00	0.00
DIPTERA	TABANIDAE	Tabanus	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	0.00	0.00	0.00	0.00	3.00	6.00
DIPTERA	TIPULIDAE	Dicranota	2.25	2.25	0.00	46.00	3.00	0.00
DIPTERA	TIPULIDAE	Hesperoconopa	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Hexatoma	4.50	4.50	0.00	16.00	18.00	3.00
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	2.00	0.00	0.00
DIPTERA	TIPULIDAE	Tipula	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified	2.25	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified (Pupa)	0.00	0.00	0.00	0.00	6.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	171.00	202.50	321.00	92.00	132.00	93.00
EPHEMEROPTERA	EPHEHERELLIDAE	Drunella coloradensis	0.00	2.25	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEHERELLIDAE	Drunella doddsi	9.00	2.25	42.00	2.00	18.00	33.00
EPHEMEROPTERA	EPHEHERELLIDAE	Drunella spinifera	0.00	20.25	30.00	4.00	0.00	3.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Summer 1991 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	2.25	0.00	3.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	0.00	0.00	4.0"	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	4.50	6.75	108.00	4.00	0.00	57.00
EPHEMEROPTERA	EPHEMERELLIDAE	Iimpanoga	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	4.50	40.50	0.00	38.00	60.00	18.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	9.00	0.00	6.00	0.00	150.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	15.75	85.50	6.00	0.00	3.00	15.00
EPHEMEROPTERA	HEPTAGENIIDAE	Heptagenia	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	22.50	27.00	21.00	18.00	39.00	3.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	P. bicornuta	0.00	0.00	0.00	0.0"	0.00	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	13.50	6.75	0.00	0.00	0.00	0.00
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	0.00	0.00	0.00	0.00	0.00	24.00
GASTROPODA	PHYSIDAE	Physa	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PLANORBIDAE	Gyraulus	0.00	0.00	0.00	0.0"	0.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.00	0.00	0.00	0.00	0.00	0.00
NEMATODA	UNIDENTIFIED	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
ODONATA	GOMPHIDAE	Octogomphus	0.00	0.00	0.00	0.0"	0.00	0.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	0.00	0.00	0.00	2.00	0.00	15.00
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	0.00	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	NAIDIDAE	Naididae	38.25	189.00	9.00	0.00	39.00	0.00
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CAPNIIDAE	Capniidae	0.00	0.00	0.00	0.0"	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	62.00	0.00	9.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	2.25	3.00	0.00	0.00	12.00
PLECOPTERA	CHLOROPERLIDAE	Neaviperla	2.25	11.25	15.00	0.0"	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	78.75	22.50	186.00	0.00	63.00	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.00	0.00	0.00	4.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Amphinemura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	9.00	2.25	3.00	26.00	9.00	3.00
PLECOPTERA	PELTOPERLIDAE	Soliperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	10.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	0.00	4.50	3.00	0.00	0.00	12.00
PLECOPTERA	PERLIDAE	Claassenia	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	11.25	0.00	9.00	12.00	0.00	24.00
PLECOPTERA	PERLIDAE	Hesperoperla	0.00	9.00	9.00	16.00	9.00	66.00
PLECOPTERA	PERLODIDAE	Cultus	2.25	2.25	0.00	0.00	3.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	0.00	0.00	0.00	0.04	0.00	0.00
PLECOPTERA	PERLODIDAE	Kogotus	0.00	0.00	3.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Perlinodes	0.00	0.00	0.00	0.00	0.00	24.00
PLECOPTERA	PERLODIDAE	Setvena	0.00	0.00	0.00	0.00	6.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	40.50	2.25	27.00	10.00	117.00	33.00
PLECOPTERA	PERLODIDAE	Unidentified	0.00	0.00	0.00	0.00	6.00	0.00
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	0.00	0.00	0.00	0.00	0.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Summer 1991 Synoptic Taxonomic List: Cascade Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	American River	Entiat River	Greenwater River	Hedrick Creek	Middle Fork Teanaway River	Trapper Creek
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	0.00	4.50	0.00	0.00	0.00	6.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	0.00	0.00	0.00	8.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	9.00	24.75	3.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	0.00	0.00	0.00	0.00	3.00	9.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	0.00	0.00	0.00	0.00	6.00	3.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma (Pupa)	0.00	0.00	0.00	0.00	3.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	6.75	18.00	3.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	0.00	0.00	0.00	0.00	6.00
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	0.00	4.50	12.00	0.00	30.00	3.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	12.00	0.00	3.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Apatania	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Clostoeca	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Dicosmoecus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisocosmoecus	0.00	0.00	0.00	0.00	0.00	9.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	18.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	0.00	0.00	3.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	24.75	13.50	18.00	0.00	3.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	4.50	0.00	0.00	12.00	0.00	3.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	9.00	0.00	0.00	2.00	0.00	36.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila (Pupa)	11.25	9.00	12.00	6.00	0.00	0.00
TRICHOPTERA	UNIDENTIFIED	Unidentified (Pupa)	0.00	2.25	0.00	0.00	6.00	0.00
TRICLADIDA	PLANARIIDAE	Planariidae	2.25	2.25	6.00	0.00	0.00	18.00

Note: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Summer 1991 Synoptic Taxonomic List: Columbia Basin Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring Creek	Umtanum Creek
ACARI	UNIDENTIFIED	Hydracarina	2.00	2.50	6.75	3.00	8.00	0.00
COLEOPTERA	CHRYSOMELIDAE	Donacia (Adult)	0.00	2.50	0.00	0.00	0.00	0.00
COLEOPTERA	DYTISCIDAE	Hydaticus	0.00	0.00	0.00	0.00	4.00	0.00
COLEOPTERA	DYTISCIDAE	Hydrovatus	0.00	0.00	0.00	0.00	6.00	0.00
COLEOPTERA	ELMIDAE	Cleptelmis	0.00	0.00	2.25	15.00	0.00	0.00
COLEOPTERA	ELMIDAE	Heterlimnius	0.00	2.50	0.00	0.00	0.00	10.50
COLEOPTERA	ELMIDAE	Heterlimnius (Adult)	12.00	2.50	0.00	0.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus	72.00	5.00	78.75	30.00	10.00	14.00
COLEOPTERA	ELMIDAE	Optioservus (Adult)	56.00	0.00	38.25	15.00	0.00	0.00
COLEOPTERA	ELMIDAE	Optioservus (Pupa)	0.00	0.00	0.00	0.00	0.00	5.25
COLEOPTERA	ELMIDAE	Stenelmis	6.00	2.50	0.00	0.00	0.00	5.25
COLEOPTERA	GYRINIDAE	Gyrinidae	0.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae	2.00	0.00	0.00	0.00	0.00	0.00
COLEOPTERA	HYDROPHILIDAE	Hydrophilidae (Adult)	0.00	0.00	0.00	0.00	2.00	0.00
COLEOPTERA	PSEPHENIDAE	Psephenus	0.00	32.50	0.00	0.00	0.00	0.00
COLLEMBOLA	UNIDENTIFIED	Collembola	0.00	0.00	0.00	0.00	0.00	0.00
DECAPODA	ASTACIDAE	Pacifasticus leniusculus	6.00	2.50	2.25	3.00	0.00	49.00
DIPTERA	ATHERICIDAE	Atherix	2.00	0.00	15.75	0.00	0.00	0.00
DIPTERA	BLEPHARICERIDAE	Agathon	0.00	0.00	20.25	0.00	0.00	0.00
DIPTERA	CERATOPOGONIDAE	Bezzia	0.00	0.00	0.00	3.00	0.00	0.00
DIPTERA	CHIRONOMIDAE	Chironomidae	16.00	400.00	119.25	309.00	94.00	36.75
DIPTERA	CHIRONOMIDAE	Chironomidae (Pupa)	0.00	25.00	6.75	3.00	8.00	3.50
DIPTERA	EMPIDIDAE	Clinocera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	EMPIDIDAE	Oreogeton	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PELECORHYNCHIDAE	Glutops	20.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PSYCHODIDAE	Maruina	8.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	PTYCHOPTERIDAE	Ptychoptera	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	SIMULIIDAE	Simuliidae	6.00	0.00	15.75	339.00	8.00	1.75
DIPTERA	SIMULIIDAE	Simuliidae (Pupa)	0.00	0.00	0.00	6.00	0.00	0.00
DIPTERA	TABANIDAE	Tabanidae (Pupa)	0.00	0.00	4.50	0.00	0.00	0.00
DIPTERA	TABANIDAE	Tabanus	2.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Antocha	2.00	0.00	47.25	12.00	6.00	0.00
DIPTERA	TIPULIDAE	Dicranota	0.00	0.00	18.00	0.00	6.00	1.75
DIPTERA	TIPULIDAE	Hesperoconopa	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Hexatoma	0.00	12.50	0.00	3.00	0.00	0.00
DIPTERA	TIPULIDAE	Limnophila	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Tipula	0.00	0.00	0.00	0.00	2.00	1.75
DIPTERA	TIPULIDAE	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
DIPTERA	TIPULIDAE	Unidentified (Pupa)	0.00	0.00	0.00	0.00	2.00	0.00
EPHEMEROPTERA	BAETIDAE	Baetis	68.00	55.00	270.00	390.00	66.00	54.25
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella coloradensis	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella doddsi	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Drunella spinifera	0.00	0.00	0.00	0.00	0.00	0.00

Nate: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Summer 1991 Synoptic Taxonomic List: Columbia Basin Streams

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring Creek	Umtanum Creek
EPHEMEROPTERA	EPHEMERELLIDAE	Ephemerella	0.00	0.00	0.0"	0.00	0.0"	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Eurylophella	0.00	7.50	4.50	3.00	14.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Serratella	14.00	0.00	9.0"	21.0"	0.00	0.00
EPHEMEROPTERA	EPHEMERELLIDAE	Timpanoga	0.00	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #1	0.00	0.00	6.75	6.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Cinygmula #2	20.00	37.50	13.5"	90.00	6.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Epeorus	6.00	10.00	0.0"	3.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Heptagenia	0.00	2.50	0.00	0.00	0.00	0.00
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena	0.0"	0.00	0.00	0.00	0.00	0.00
EPHEMEROPTERA	LEPTOPHLEBIIDAE	P. bicornuta	0.00	0.00	0.00	0.00	0.00	10.50
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia	0.00	7.56	0.0"	12.00	2.00	138.25
EPHEMEROPTERA	SIPHLONURIDAE	Ameletus	0.00	0.00	0.00	0.00	0.00	0.00
GASTROPODA	PHYSIDAE	Physa	0.00	0.0"	0.0"	0.00	8.00	0.0"
GASTROPODA	PLANORBIDAE	Gyraulus	0.00	0.0"	0.0"	0.00	2.00	0.00
MEGALOPTERA	SIALIDAE	Sialis	0.0"	0.00	0.00	0.00	4.00	1.75
NEMATODA	UNIDENTIFIED	Unidentified	0.00	15.0"	0.00	57.0"	2.00	1.75
ODONATA	GOMPHIDAE	Octogomphus	0.0"	0.00	0.00	0.00	0.00	0.00
OLIGOCHAETA	LUMBRICULIDAE	Lumbriculidae	14.00	15.00	6.75	3.""	12.00	5.25
OLIGOCHAETA	LUMBRICULIDAE	Rhynchelmis	0.00	0.00	0.00	3.00	4.00	0.00
OLIGOCHAETA	NAIDIDAE	Naididae	14.00	7.50	9.00	123.00	4.00	5.25
PELECYPODA	SPHAERIIDAE	Pisidium	0.00	0.00	18.00	6.0"	2.00	0.00
PLECOPTERA	CAPNIIDAE	Capniidae	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Haploperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Kathroperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Neaviperla	0.0"	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	CHLOROPERLIDAE	Sweltsa	24.00	7.50	4.50	75.00	0.00	0.00
PLECOPTERA	LEUCTRIDAE	Perlomyia	0.0"	0.00	11.25	0.00	0.00	0.00
PLECOPTERA	NEMOURIDAE	Amphinemura	0.00	0.00	0.00	0.00	0.00	12.25
PLECOPTERA	NEMOURIDAE	Nemoura	0.00	0.00	0.00	0.00	2.00	0.00
PLECOPTERA	NEMOURIDAE	Zapada	12.00	22.50	0.0"	36.00	98.00	49.00
PLECOPTERA	PELTOPERLIDAE	Soliperla	0.00	0.00	0.0"	0.00	0.00	0.00
PLECOPTERA	PELTOPERLIDAE	Yoraperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Calineuria	26.0"	35.00	0.00	0.00	0.00	7.00
PLECOPTERA	PERLIDAE	Claassenia	8.00	0.00	0.00	18.00	0.00	0.00
PLECOPTERA	PERLIDAE	Doroneuria	0.0"	2.50	0.00	0.00	0.00	0.00
PLECOPTERA	PERLIDAE	Hesperoperla	56.00	2.50	33.75	18.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Cultus	0.00	0.00	0.0"	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Isoperla	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Kogotus	0.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Perlinodes	0.00	0.0"	0.00	0.0"	0.00	0.00
PLECOPTERA	PERLODIDAE	Setvena	0.00	0.0"	0.0"	0.00	0.00	0.00
PLECOPTERA	PERLODIDAE	Skwala	4.00	7.5"	4.50	6.00	38.00	8.75
PLECOPTERA	PERLODIDAE	Unidentified	0.0"	0.00	0.00	0.00	0.00	1.75
PLECOPTERA	PTERONARCYIDAE	Pteronarcella	0.00	0.00	6.75	0.00	0.00	0.00

Nate: Mean density of taxa were calculated from two replicate transect collections that were two-square meters each in substrate area sampled.

Sumner 1991 Synaptic Taxonomic List: Columbia Basin Stream*

Benthic Macroinvertebrate Mean Abundance Tables
(Density of Organisms/Square Meter)

Order	Family	Genus/Species	Cummings Creek	Little Klickitat River	North Fork Asotin Creek	Naneum Creek	Spring creel:	Umtanum Creek
PLECOPTERA	PTERONARCYIDAE	Pteronarcys	22.00	0.00	0.00	0.00	0.00	0.00
PLECOPTERA	TAENIOPTERYGIDAE	Taenionema	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Brachycentrus	0.00	0.00	256.50	0.00	0.00	0.00
TRICHOPTERA	BRACHYCENTRIDAE	Micrasema	2.00	0.00	22.50	6.00	18.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma	4.00	5.00	40.50	6.00	4.00	0.00
TRICHOPTERA	GLOSSOSOMATIDAE	Glossosoma (Pupa)	12.00	17.50	33.7s	3.00	2.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Arctopsyche	24.00	0.00	0.00	45.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Ceratopsyche	0.00	0.00	0.00	3.00	0.00	0.00
TRICHOPTERA	HYDROPSYCHIDAE	Cheumatopsyche	0.00	182.50	0.00	12.00	0.00	10.50
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche	0.00	70.00	18.00	15.00	120.00	77.00
TRICHOPTERA	HYDROPSYCHIDAE	Parapsyche	0.00	0.00	0.00	0.00	6.00	0.00
TRICHOPTERA	LEPIDOSTOMATIDAE	Lepidostoma	0.00	2.50	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Apatania	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Clostoeca	0.00	2.50	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Dicosmoecus	2.00	2.50	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisocosmoecus	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Ecclisomyia	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	LIMNEPHILIDAE	Moselyana	0.00	0.00	0.00	0.00	0.00	0.00
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus	16.00	5.00	4.50	33.00	4.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #1	0.00	0.00	2.25	0.00	0.00	0.00
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila #2	0.00	0.00	9.00	12.00	0.00	1.75
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila (Pupa)	0.00	0.00	0.00	0.00	0.00	7.00
TRICHOPTERA	UNIDENTIFIED	Unidentified (Pupa)	0.00	0.00	4.50	9.00	2.00	0.00
TRICLADIDA	PLANARIIDAE	Planariidae	0.00	0.00	0.00	0.00	IO.00	0.00

Nate: Mean density of taxa were calculated from two replicate transect collections that were tuo-square meters each in substrate area sampled.

Appendix F

Surface Water Quality Tables

Bingham Creek Surface Water Field Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved oxygen (mg/L)	Oxygen Saturation (% 02 sat.1	Discharge (cubic ft./sec)
a	Apr	1991	6.1	7.2	48.0	13.3	110.0	12.55
12	Aug	1991						0.00
13	Dec	1990	6.5	7.5	54.0	12.9	107.0	17.16
5	Feb	1991	6.3	7.3	47.0	13.0	108.0	74.59
a	Jan	1991	4.9	7.3	59.0	13.0	104.0	3.91
17	June	1991	8.1	6.6	70.0	11.6	101.0	0.00
18	Mar	1991	7.1	7.1	61.0	13.6	115.0	.04
7	May	1991	a.0	6.9	77.0	11.4	99.0	.01
27	Nov	1990	6.9	7.3	56.0	14.2	119.0	40.34

Note: Extreme low discharge occurred during June 1991 sampling and the stream was dry during the August 1991 sampling date.

Bingham Creek Surface Water Laboratory Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
8	Apr	199:	0	21	15	1.2	.01	.11	.01		.16
12	Aug	1991									
13	Dec	1990	1	24	15	2.5	.01	.21	.01		.28
5	Feb	1991	7	18	15	2.0	.01	.14	.03	.02	.10
8	Jan	1991	1	21	17	.8	.01	.24	.01		.10
17	June	1991	0	29	24	1.6	.01	.13	.01		.01
18	Mar	1991	0	27	19	3.8	.01	.11	.02		.10
7	May	1991	0	29	25	2.1	.01	.10	.04	.01	.10
27	NO"	1990	2	22	18	1.5	.01	.24	.02		.35

Note: Extreme low discharge occurred during June 1991 sampling and the stream was dry during the August 1991 sampling date.

Dewatto River Surface Wafer Field Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen saturation (%O2 Sat.)	Discharge (cubic ft./sec)
8	Apr	1991	7.3	7.2	24.0	12.6	105.0	41.56
13	Aug	1991	15.5	6.7	65.0	8.7	88.0	2.55
13	Dec	1990	5.8	6.9	28.0	12.4	100.0	27.39
5	Feb	1991	6.7	6.9	21.0	13.2	109.0	16.87
8	Jan	1991	2.5	7.4	48.0	13.3	98.0	14.06
17	June	1991	12.0	7.0	56.0	9.2	86.0	3.32
18	Mar	1991	6.8	7.2	38.0	13.0	107.0	9.37
a	May	1991	10.6	7.7	45.0	10.4	94.0	8.78
26	Nov	1990	7.7	7.0	33.0	13.3	112.0	

Dewatto River Surface Water Laboratory Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
8	Apr	1991	.4	il	10	3.0	.01	.02	.01		.01
13	Aug	1991	.7	30	28	3.9	.01	.06	.01	.02	.19
13	Dec	1990	1.0	12	10	3.5	.01	.11	.01		.32
5	Feb	1991	1.0	6	7	3.1	.01	.07	.01	.01	.10
8	Jan	1991	1.0	16	16	2.9	.02	.21	.03		.10
17	June	1991	.5	26	25	2.6	.01	.04	.01		.12
18	Mar	1991	.6	14	11	3.2	.01	.06	.01		.12
8	May	1991	1.1	19	20	3.0	.01	.05	.01	.02	3.90
26	Nov	1990	1.0	11	13	4.3	.01	.22	.01	.01	.41

Seabeck Creek Surface Water Field Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved oxygen (mg/L)	Oxygen saturation (%02 Sat.)	Discharge (cubic ft./sec)
8	Apr	1991	6.9	7.0	29.0	'13.2	109.0	6.85
12	Aug	1991	12.8	7.4	98.0	9.8	93.0	.38
13	Dec	1990	5.8	7.5	33.0	'12.7	102.0	4.89
5	Feb	1991	7.0	7.1	28.0	'13.2	109.0	36.08
8	Jan	1991	1.2	7.2	41.0	'13.4	95.0	
17	June	1991	10.7	7.5	91.0	'10.6	96.0	.27
18	Mar	1991	5.9	7.0	37.0	'13.2	106.0	6.85
7	May	1991	9.4	7.6	81.0	'11.4	100.0	1.10
26	Nov	1990	7.4	7.6	34.0	'14.0	117.0	'10.46

Seabeck Creek Surface Water Laboratory Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
8	Apr	1991	.5	9	11	3.1	.01	.15	.01		.10
12	Aug	1991	.5	42	44	2.8	.01	.45	.02	.03	.43
13	Dec	1990	1.0	11	13	4.1	.01	.33	.01		.56
5	Feb	1991	3.7	6	8	4.3	.02	.26	.02	.01	.13
8	Jan	1991	1.0	9	14	3.6	.02	.40	.01		.10
17	June	1991	.2	39	37	1.5	.01	.42	.01		.42
18	Mar	1991	.1	12	11	3.4	.01	.25	.01		.10
7	May	1991	.4	33	34	2.1	.01	.28	.15	.01	.61
26	Nov	1990	1.0	8	19	5.8	.01	.57	.01	.01	.68

Snow Creek Surface Water Field Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
8	Apr	1991	5.1	8.0	69.0	14.4	114.0	43.81
12	Aug	1991	13.1	7.2	135.0	10.0	96.0	3.45
13	Dec	1990	3.4	7.5	78.0	13.4	102.0	21.66
5	Feb	1991	5.8	7.6	64.0	13.4	108.0	24.97
8	Jan	1991	1.5	7.5	106.0	13.8	99.0	5.28
17	June	1991	9.4	7.7	70.0	10.8	95.0	14.24
18	Mar	1991	4.5	8.2	88.0	14.0	109.0	15.63
7	May	1991	9.2	8.0	102.0	11.6	102.0	8.27
26	NO"	1990	3.9	7.7	80.0	14.9	115.0	32.43

Snow Creek Surface Water Laboratory Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-h (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
8	Apr	1991	3.1	21	25	5.7	.01	.38	.01		.01
12	Aug	1991	.3	55	54	5.9	.01	.11	.02	.02	.19
13	Dec	1990	2.0	25	29	8.0	.01	.83	.02		1.07
5	Feb	1991	33.0	13	25	8.8	.01	.76	.11	.03	.10
8	Jan	1991	1.0	36	41	4.0	.01	.47	.03		.45
17	June	1991	.8	34	35	5.7	.01	.11	.02		.19
18	Mar	1991	.8	26	30	6.4	.01	.34	.02		.10
7	May	1991	.8	38	39	4.1	.01	.05	.02	.01	.10
26	Nov	1990	4.7	21	31	13.9	.01	1.33	.04	.01	1.43

Tahuya River Surface Water Field Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
8	Apr	1991	7.5	7.2	42.0	12.3	104.0	90.47
13	Aug	1991	15.7	6.6	66.0	8.6	88.0	.21
13	Dec	,990	5.6	7.2	47.0	12.1	98.0	67.08
5	Feb	1991	6.9	6.8	41.0	12.8	107.0	29.27
8	Jan	1991	1.5	7.0	50.0	13.2	96.0	25.12
17	June	1991	14.2	7.2	56.0	9.2	91.0	2.39
18	Mar	1991	6.8	7.1	53.0	13.0	108.0	25.04
8	May	1991	11.1	7.8	56.0	10.3	95.0	16.54
26	Nov	1990	7.6	7.0	54.0	12.7	108.0	

Tahuya River Surface Waler Laboratory Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
8	Apr	1991	.5	18	18	2.8	.01	.03	.01		.36
13	Aug	1991	.5	29	27	5.1	.01	.01	.01	.01	.14
13	Dec	1990	1.0	12	11	3.8	.01	.18	.01		.37
5	Feb	1991	1.1	13	14	3.3	.01	.14	.01	.01	.10
8	Jan	1991	1.0	18	20	1.9	.02	.17	.01		.10
17	June	1991	.7	27	26	2.6	.01	.01	.0i		.15
18	Mar	1991	.3	20	20	3.0	.02	.06	.01		.10
8	May	1991	1.2	23	22	2.7	.01	.01	.01	.01	.10
26	NO"	1990	1.0	i i	i9	4.0	.01	.24	.01	.01	.42

Toboton Creek Surface Water Field Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cu.ft/sec)
9	Apr	1991	6.9	7.2	60.0	12.3	103.0	11.98
14	Aug	1991	13.4	6.7	124.0	9.6	93.0	1.55
14	Dec	1990	4.7	7.5	79.0	13.4	106.0	4.83
7	Feb	1991	4.0	7.1	66.0	12.7	98.0	9.32
9	Jan	1991	1.3	7.4	72.0	14.2	102.0	7.68
18	June	1991	'10.4	7.0	99.0	1Cl.4	95.0	1.01
19	Mar	1991	5.2	7.6	74.0	14.1	113.0	4.36
8	May	1991	9.6	7.3	79.0	10.4	93.0	6.76
27	Nov	,990	5.9	7.2	72.0	13.1	107.0	7.49

Toboton creek surface Water Laboratory Parameters

Puget Lowlands Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
9	Apr	1991	4.9	25	25	8.8	.05	.08	.02		1.05
14	Aug	1991	2.2	53	47	5.2	.01	.04	.06	.04	.17
14	Dec	1990	3.0	30	24	11.3	.02	.28	.04		.81
7	Feb	1991	4.2	22	23	14.4	.01	.15	.03	.02	.10
9	Jan	1991	6.1	21	23	11.6	.07	.40	.03		.21
18	June	1991	2.8	44	39	5.8	.01	.03	.21		.05
19	Mar	1991	8.5	31	27	7.2	.01	.02	.04		.30
8	May	1991	6.8	33	32	12.7	.02	.05	.09	.01	.35
27	Nov	1990	3.7	20	28	19.3	.01	.14	.08		.79

Entiat River Surface Water Field Parameters

Cascades Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
16	Apr	1991	4.1	7.2	46.0	11.6	95.0	261.39
29	Aug	1991	9.7	7.2	42.0	10.8	102.0	206.85
5	Dec	1990	1.8	7.1	39.0	14.3	110.0	327.14
12	Feb	1991	2.4	a.0	48.0	12.9	101.0	'151.16
10	Jan	1991	.5	7.3	50.0	13.9	104.0	115.31
24	June	1991	7.7	6.8	34.0	10.6	95.0	1393.15
21	Mar	1991	3.3	7.0	47.0	13.9	112.0	184.88
21	May	1991	5.8	6.9	43.0	12.0	103.0	2062.08
12	Nov	1990	3.1	7.0	35.0	15.1	121.0	70.67

Entiat River Surface Water Laboratory Parameters

Cascades Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phophorus (mg/L)	Ortho-Phosphorus (mg/L)	Total Persulfate-N (mg/L)
16	Apr	,991	1.9	19	18	2.6	.01	.01	.01		.10
29	Aug	1991	1.6	16	13	2.4	.01	.01	.01	.01	.10
5	Dec	,990	1.0	16	15	2.2	.01	.02	.01		.14
12	Feb	1991	1.0	19	17	1.8	.01	.01	.01	.02	.10
10	Jan	1991	1.0	18	16	1.3	.01	.02	.01		.10
24	June	1991	.5	12	11	1.2	.01	.01	.01		.10
21	Mar	1991	.1	20	17	2.1	.01	.01	.01		.12
21	May	1991	4.5	12	12	2.2	.02	.02	.07	.02	.10
12	Nov	1990	1.0	15	13	2.8	.01	.03	.01	.03	.01

Greenwater River Surface Water Field Parameters

Cascades Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
9	Apr	1991	3.8	7.8	55.0	14.3	118.0	230.35
14	Aug	1991	15.6	6.9	82.0	9.0	98.0	36.44
14	Dec	1990	2.9	7.1	54.0	12.9	104.0	183.65
6	Feb	1991	4.4	7.8	49.0	13.8	116.0	317.54
9	Jan	1991	2.4	7.4	63.0	13.8	110.0	79.97
18	June	1991	10.1	7.4	56.0	10.1	98.0	192.03
19	Mar	1991	3.9	8.4	56.0	13.2	109.0	128.10
9	May	1991	4.4	7.4	53.0	11.8	99.0	235.02
21	Nov	1990	4.3	7.8	59.0	14.6	123.0	

Greenwater River Surface Water Laboratory Parameters

Cascades Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
9	Apr	1991	1.0	23	20	1.2	.01	.01	.01		10.00
14	Aug	1991	.2	29	21	2.9	.02	.01	.03	.02	.10
14	Dec	1990	1.2	25	17	1.8	.01	.03	.03		.17
6	Feb	1991	1.5	21	17	2.5	.01	.02	.02	.03	.10
9	Jan	1991	1.0	26	21	1.1	.01	.01	.01		.10
18	June	1991	.5	23	17	1.5	.01	.01	.02		.10
19	Mar	1991	2.4	24	19	1.3	.01	.01	.02		.10
9	May	1991	2.9	23	18	1.8	.01	.01	.03	.02	.10
21	Nov	1990	1.0	25	21	1.8	.01	.02	.03	.02	.09

Hedrick Creek Surface Water Field Parameters

Cascades Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
15	Apr	1991	6.6	7.3	56.0	14.4	122.0	5.87
28	Aug	1991	11.4	7.3	76.0	11.0	104.0	2.57
20	Dec	1990	.3	7.3	48.0	12.1	87.0	7.88
8	Feb	1991	4.8	7.2	45.0	13.5	109.0	25.12
14	Jan	1991	3.9	7.4	34.0	13.8	109.0	34.53
24	June	1991	9.8	7.0	40.0	9.9	91.0	7.86
20	Mar	1991	5.5	7.3	57.0	14.2	117.0	4.43
9	May	1991	5.5	7.3	38.0	11.4	94."	14.36
20	Nov	1990	3.1	7.3	47.0	15.7	121.0	14.40

Hedrick Creek Surface Water Laboratory Parameters

Cascades Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Perulfate-N (mg/L)
15	Apr	199i	i.5	24	23	1.2	.02	.01	.01		.10
28	Aug	1991	1.5	28	43	3.9	.01	.07	.01	.01	.13
20	Dec	1990	1.0	21	20	2.5	.01	.07	.01		.10
8	Feb	1991	3.8	18	17	2.1	.01	.06	.01	.01	
14	Jan	1991	5.1	16	16	4.7	.07	.07	.01		.10
24	June	1991	1.0	19	17	1.6	.01	.01	.01		.10
20	Mar	1991	.4	25	21	3.0	.01	.01	.01		.10
9	May	1991	2.5	18	20	1.7	.01	.01	.01	.01	.01
20	Nov	1990	1.0	20	21	2.0	.01	.11	.01	.01	.01

Middle Fork Teanaway River Surface Water Field Parameters

Cascades Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
16	Apr	1991	5.7	7.6	99.0	10.8	95.0	127.73
29	Aug	1991	15.3	7.5	120.0	8.2	90.0	7.80
19	Dec	1990	0.0	7.1	102.0	13.6	102.0	
11	Feb	1991	4.2	7.9	112.0	11.4	96.0	32.54
17	Jan	1991	3.2	7.8	90.0	11.8	97.0	124.00
25	June	1991	8.7	7.4	66.0	10.3	97.0	42.79
15	Mar	1991	3.8	7.5	102.0	12.8	107.0	45.07
21	May	1001	a.5	7.4	70.0	10.5	99.0	
21	Nov	1990	2.8	8.0	92.0	14.5	118.0	59.01

Middle Fork Teanaway surface Water Laboratory Parameters

Cascades Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
16	Apr	1991	2.0	45	43	3.1	.01	.01	.01		.10
29	Aug	1991	1.6	55	53	2.4	.01	.01	.01	.01	.10
19	Dec	1990	1.3	47	45	3.9	.01	.01	.01		.10
11	Feb	1991	1.3	46	44	2.9	.01	.01	.01	.02	.10
17	Jan	1991	3.8	44	41	2.3	.01	.01	.01		.10
25	June	1991	.5	30	27	1.2	.01	.01	.01		.10
15	Mar	1991	1.6	47	45	3.5	.01	.03	.01		.10
21	May	1001	5.3	27	28	3.0	.03	.02	.02	.02	
21	Nov	1990	1.0	42	40	2.7	.01	.01	.01	.01	.05

American River Surface Water Field Parameters

Cascades Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
16	Apr	1991	5.6	7.3	68.0	11.3	100.0	227.00
29	Aug	1991	9.1	7.4	79.0	9.8	95.0	144.00
6	Dec	1990	1.7	8.1	54.0	12.1	97.0	192.00
13	Feb	1991	3.5	8.2	61.0	11.8	99.0	280.00
11	Jan	1991	1.7	6.9	71.0	12.1	97.0	92.00
25	June	1991	7.2	7.0	52.0	9.9	92.0	404.00
22	Mar	1991	2.4	7.3	69.0	12.7	104.0	132.00
20	May	1991	6.4	7.3	46.0	10.0	91.0	565.00
13	Nov	1990	5.2	9.0	53.0	13.6	120.0	188.00

American River Surface Water Laboratory Parameters

Cascades Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total organic c (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-h (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
16	Apr	1991	i.2	28	27	2.0	.01	.02	.01		.10
29	Aug	1991	3.7	31	53	2.9	.01	.01	.03		.10
6	Dec	1990	1.0	24	23	3.4	.01	.02	.01		.14
13	Feb	1991	1.0	25	23	3.4	.01	.01	.01	.02	.10
11	Jan	1991	1.0	28	26	1.0	.01	.01	.01		.10
25	June	1991	.9	19	20	1.7	.01	.01	.01	.10	.10
22	Mar	1991	.7		25	1.6	.01	.01	.01		.10
20	May	1991	3.3	20	20	2.8	.02	.02	.05	.02	.10
13	Nov	1990	1.0	21	19	1.6	.01	.01	.01	.01	.01

Trapper Creek Surface Water Field Parameters

Cascades Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
10	Apr	1991	3.9	7.0	39.0	13.1	106.0	100.14
19	Aug	1991	14.6	6.9	104.0	8.8	92.0	3.98
I?	Dec	1990	3.6	7.4	50.0	13.6	109.0	45.49
14	Feb	1991	5.4	7.4	44.0	11.4	96.0	1.03
15	Jan	1991	4.6	7.2	28.0	12.7	105.0	
19	June	1991	9.5	7.1	65.0	10.0	94.0	10.60
13	Mar	1991	3.4	7.4	48.0	13.8	111.0	40.39
13	May	1991	5.8	7.2	48.0	13.6	116.0	54.66
16	NO"	1990	5.6	7.1	43.0	14.4	122.0	77.58

Trapper Creek Surface Water Laboratory Parameters

cascades Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
10	Apr	1991	.2	16	15	1.0	.01	.03	.01		.i0
19	Aug	1991	.8	34	32	2.2	.04	.04	.01	.01	.12
17	Dec	1990	1.0	19	19	1.2	.01	.02	.02		.10
14	Feb	1991	1.0	13	11	2.0	.01	.01	.01	.oo	.10
15	Jan	1991	3.2	12	10	2.5	.01	.01	.01		.10
19	June	1991	.2	24	21	1.0	.01	.03	.01		.10
13	Mar	1991	1.5	19	16	2.5	.01	.01	.06		.10
13	May	1991	.3	16	12	1.7	.01	.01	.01	.02	.10
16	Nov	1990	1.0	17	15	1.2	.01	.01	.01	.01	.01

Cummings Creek Surface Water Field Parameters

Columbia Basin Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
11	Apr	1991	4.5	7.6	85.0	11.6	98.0	10.28
20	Aug	1991	15.8	7.7	110.0	9.2	101.0	2.48
18	Dec	1990	3.2	7.9	98.0	12.1	98.0	4.75
20	Feb	1991	7.2	8.0	91.0	11.0	99.0	8.19
1b	Jan	1991	4.1	8.1	82.0	12.5	104.0	9.90
20	June	1991	9.6	7.4	76.0	9.6	92.0	6.18
14	Mar	1991	4.4	7.7	89.0	14.2	119.0	9.12
14	May	1991	a.4	7.4	82.0	10.4	97.0	10.51
14	Nov	1990	6.0	7.6	100.0	13.8	121.0	3.39

Cummings Creek Surface Water Laboratory Parameters

Columbia Basin Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as $CaCO_3$)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
II	Apr	1991	2.5	38	33	2.8	.02	.10	.05		4.60
20	Aug	1991	2.3	51	42	3.6	.04	.07	.07	.04	.18
18	Dec	1990	1.0	47	41	2.4	.01	.06	.03		.10
20	Feb	1991	3.2	38	32	4.3	.01	.04	.05	.04	.10
16	Jan	1991	6.3	44	39	3.0	.01	.16	.06		.01
20	June	1991	1.6	43	37	2.2	.01	.02	.05		.10
14	Mar	1991	2.6	41	35	5.6	.01	.03	.05		.10
14	May	1991	1.8	37	32	4.9	.01	.01	.03	.04	.10
14	Nov	1990	1.0	48	42	2.5	.01	.02	.04	.05	.01

Little Klickitat River Surface Water Field Parameters

Columbia Basin Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
10	Apr	1991	7.7	7.5	69.0	12.6	113.0	101.25
19	Aug	1991	28.3	8.5	'112.0	8.4	115.0	.81
17	Dec	1990	3.6	8.1	'105.0	13.3	107.0	19.86
14	Feb	1991	5.4	8.0	74.0	11.7	99.0	87.46
15	Jan	1991	3.2	7.5	68.0	11.9	95.0	153.00
19	June	1991	15.9	8.0	88.0	8.7	94.0	11.73
13	Mar	1991	5.7	8.1	'79.0	14.3	122.0	69.15
13	May	1991	13.2	7.4	89.0	10.2	104.0	32.54
28	Nov	,990	3.9	7.6	"0.0	12.9	105.0	17.74

Little Klickitat River surface Water Laboratory Parameters

Columbia Basin Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total organic c (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-h (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
IO	Apr	199i	2.5	32	29	2.6	.01	.01	.01		.97
19	Aug	1991	2.8	71	57	3.2	.04	.02	.04	.18	.02
17	Dec	1990	1.0	50	42	3.3	.01	.01	.01		.10
14	Feb	1991	3.7	35	30	5.7	.01	.01	.03	.01	.10
15	Jan	1991	10.5	31	27	4.1	.01	.07	.06		.29
19	June	1991	.6	42	34	1.5	.01	.01	.01		.01
13	Mar	1991	3.5	34	29	4.2	.01	.01	.03		.10
13	May	1991	i.8	34	30	5.0	.01	.01	.02	.01	.01
28	Nov	1990	1.3	36	29	4.1	.01	.01	.02		.16

North Fork Asotin Creek Surface Water Field Parameters

Columbia Basin Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
11	Apr	1991	9.2	7.6	'76.0	10.6	101.0	41.93
20	Aug	1991	18.2	7.6	108.0	8.8	102.0	21.56
18	Dec	1990	4.9	8.4	91.0	12.7	108.0	25.96
20	Feb	1991	6.4	7.9	87.0	10.9	97.0	36.86
16	Jan	1991	5.2	8.1	'70.0	11.8	102.0	40.82
20	June	1991	10.7	7.5	'74.0	10.0	98.0	40.92
14	Mar	1991	5.7	8.3	87.0	13.6	119.0	36.33
14	May	1991	8.6	7.5	62.0	10.8	101.0	107.37
14	Nov	1990	7.8	8.0	95.0	13.2	121.0	24.74

North Fork Asotin Creek Surface Water Laboratory Parameters

Columbia Basin Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	iota, Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
ii	Apr	1991	3.1	37	32	3.5	.03	.01	.04		.10
20	Aug	1991	1.4	47	37	3.9	.04	.06	.04	.03	.23
18	Dec	1990	1.0	43	37	2.4	.01	.06	.04		.10
20	Feb	1991	2.0	39	32	5.0	.01	.05	.05	.04	.10
16	Jan	1991	3.7	40	33	3.0	.01	.08	.07		.10
20	June	1991	1.7	35	29	1.9	.01	.02	.04		.10
14	Mar	1991	2.5	40	33	3.5	.01	.03	.05		.10
14	May	1991	. 2.6	27	25	4.1	.01	.01	.04	.03	.10
14	NO"	1990	1.0	45	37	1.6	.01	.04	.03	.04	.01

Naneum Creek Surface Water Field Parameters

Columbia Basin Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved oxygen (mg/L)	Oxygen Saturation (%O2 sat.)	Discharge (cubic ft./sec)
12	Apr	1991	8.6	7.3	96.0	11.8	111.0	48.31
21	Aug	1991	18.3	7.6	102.0	8.6	101.0	11.99
19	Dec	1990	0.0	7.4	95.0	14.1	106.0	
12	Feb	1991	3.1	8.3	90.0	12.3	101.0	25.22
17	Jan	1991	.7	7.9	91.0	12.8	98.0	24.58
21	June	1991	9.0	7.5	69.0	10.2	97.0	95.10
14	Mar	1991	3.1	8.5	98.0	13.2	108.0	33.12
21	May	1991	8.9	7.3	68.0	11.0	105.0	92.44
13	Nov	1990	5.4	8.0	85.0	13.5	118.0	16.99

Naneum Creek Surface Water Laboratory Parameters

Columbia Basin Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as $CaCO_3$)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
12	Apr	1991	3.9	43	38	2.5	.03	.01	.03		.10
21	Aug	1991	2.3	42	34	4.c	.04	.02	.05		
19	Dec	1990	1.6	41	37	5.2	.01	.03	.04		.10
12	Feb	1991	5.4	42	38	4.6	.01	.02	.03	.06	.10
17	Jan	1991	3.2	44	33	2.3	.01	.04	.04		1.68
21	June	1991	2.7	31	27	3.5	.01	.01	.03		.10
14	Mar	1991	2.6	43	37	5.3	.01	.01	.03		.10
21	May	1991	2.6	30	27	3.2	.01	.01	.04	.02	.10
i3	Nov	1990	1.0	42	36	2.4	.01	.01	.03	.03	.01

Spring Creek Surface Water Field Parameters

Columbia Basin Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
12	Apr	1991	8.4	8.4	360.0	13.2	119.0	.80
21	Aug	1991	14.0	7.9	345.0	8.9	92.0	.30
19	Dec	1990	-.1	8.3	400.0	14.5	105.0	
21	Feb	1991	2.4	8.0	350.0	12.4	96.0	1.14
17	Jan	1991	1.3	8.4	200.0	12.9	97.0	1.87
21	June	1991	10.5	8.3	334.0	9.9	94.0	.28
14	Mar	1991	2.7	8.2	320.0	13.3	104.0	1.36
15	May	1991	7.8	8.1	34s. 0	10.6	94.0	.75
15	NO"	1990	4.4	8.1	350.0	15.2	124.0	.79

Spring Creek Surface Water Laboratory Parameters

Columbia Basin Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total Organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-h (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
12	Apr	1991	1.5	149	140	4 8	.05	2.66	.06		2.50
21	Aug	1991	2.8	153	98	3.0	.04	2.20	.06	.06	2.03
19	Dec	1990	1.0	155	150	3.7	.01	3.52	.03		2.98
21	Feb	1991	2.4	151	140	4.9	.01	3.16,	.08	.08	3.00
17	Jan	1991	61.0	78	72	12.7	.06	1.94	.21		2.56
21	June	1991	1.1	147	133	1.9	.02	2.70	.05		2.50
14	Mar	1991	2.3	153	144	3.2	.01	3.06	.06		2.24
15	May	1991	1.4	153	142	6.7	.01	2.34	.05	.03	1.26
15	NO"	1990	1.0	139	138	4.4	.01	3.71	.05	.06	3.24

Umtanum Creek Surface Water Field Parameters

Columbia Basin Ecoregion

Day	Month	Year	Temperature (Celsius)	pH (units)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%O2 Sat.)	Discharge (cubic ft./sec)
16	Apr	1991	12.5	8.1	219.0	10.3	101.0	2.01
29	Aug	1991	18.2	8.1	230.0	7.9	89.0	.27
6	Dec	1990	3.1	7.9	x19.0	12.4	98.0	1.54
13	Feb	1991	3.6	8.2	194.0	12.2	98.0	2.18
11	Jan	1991	1.9	8.2	218.0	13.2	101.0	1.49
25	June	1991	15.2	8.0	200.0	8.2	87.0	.a7
21	Mar	1991	9.1	8.2	206.0	11.9	109.0	2.39
20	May	1991	16.3	8.2	215.0	8.2	89.0	1.39
13	ND"	1990	9.0	8.3	225.0	12.9	118.0	1.91

Umtanum Creek Surface Water Laboratory Parameters

Columbia Basin Ecoregion

Day	Month	Year	Turbidity (NTU)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L)	Total organic C (mg/L)	Ammonia-N (mg/L)	Nitrate+ Nitrite-N (mg/L)	Total Phosphorus (mg/L)	Ortho-Phosphate (mg/L)	Total Persulfate-N (mg/L)
16	Apr	199:	1.8	103	83	5.6	.02	.01	.86		.10
29	Aug	1991	3.0	130	100	3.5	.01	.01	.10	.12	.13
6	Dec	1990	1.0	106	85	7.7	.03	.01	.08		.35
13	Feb	1991	1.0	95 .	77	9.0	.01	.01	.07	.11	.10
11	Jan	1991	1.0	99	81	2.3	.01	.01	.02		.10
25	June	1991	.9	119	92	2.4	.01	.01	.08		.10
21	Mar	1991	.3		76	2.9	.01	.02	.09		.10
20	May	1991	7.5	112	90	7.7	.02	.02	.10	.02	.75
13	NO"	1990	1.0	110	95	2.0	.01	.01	.08	.08	.01

Appendix G

Benthic Macroinvertebrate Occurrence Frequency Tables

TWINSPAN - FALL 1990 BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Puget Lowlands

Frequently Present (3-6 Sites)	Occasionally Present (1-2 Sites)
Chironomidae	Ephemeroptera
	Paraleptophlebia
	Serratella
	Plecoptera
	Isoperla
	Cultus
	Hesperoperla
	Calineuria
	Trichoptera
	Rhyacophila #1
	Rhyacophila #2
	Ceratopsyche
	Coleoptera
	Heterlimnius
	Diptera
	Hexatoma
	Decapoda
	Pacifasticus leniusculus

TWINSPAN - FALL 1990 BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Columbia Basin

Frequently Present (3-6 Sites)

Plecoptera
- *Hesperoperla*

Coleoptera
- *Optioserws*

Diptera
- Chironomidae
- Simuliidae
- *Antocha*

Occasionally Present (1-2 Sites)

Ephemeroptera
- *Cinygmula #2*
- *Paraleptophlebia*
- *Epeorus*
- *Serratella*

Plecoptera
- *Doroneuria*
- *Cultus*
- *Perlomyia*
- *Calineuria*
- *Pteronarcys*

Trichoptera
- *Cheumatopsyche*
- *Polycentropus*
- *Glossosoma*
- *Brachycentrus*

Megaloptera
- *Sialis*

Diptera
- *Hexatoma*

Coleoptera
- *Psephenus*

Decapoda
- *Pacifasticus leniusculus*

Gastropoda
- *Physa*

Oligochaeta
- *Rhynchelmis*

TWINSPAN - **FALL 1990** BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Cascades

Frequently Present (3-6 Sites)

Ephemeroptera
- *Drunella doddsi*

Occasionally Present (1-2 Sites)

Ephemeroptera
- *Drunella spinifera*
- *Serratella*
- *Epeorus*

Plecoptera
- *Doroneuria*
- *Skwala*
- *Osohenus*
- *Isoperla*
- *Cultus*

Trichoptera
- *Ecclisomyia*
- *Glossosoma*
- *Neophylax*
- *Ceratopsyche*
- *Brachycentrus*
- *Rhyacophila* #1
- *Rhyacophila* #2

Diptera
- *Antocha*

TWINSPAN - FALL 1990 BENTHIC MACROINVERTEBRATES

TAXA WITH DISTRIBUTION AMONG ALL ECOREGIONS

Frequently Present (3-6 Sites)	Occasionally Present (1-2 Sites)
Ephemeroptera	Ephemeroptera
Rithrogena	*Cinygmula #1*
	Baetis
	Plecoptera
	Sweltsa
	Zapada
	Trichoptera
	Hydropsyche
	Oligochaeta
	Lumbriculidae

Note: "Frequently Present" taxa appeared at 3-6 sites within each of the three ecoregions. "Occasionally Present" taxa appeared at 1-2 sites within each of the three ecoregions during the season.

TWINSPAN - WINTER 1991 BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Puget Lowlands

Freauentlv Present (3-6 Sites)	Occasionally Present (1-2 Sites)
Ephemeroptera	Ephemeroptera
Paraleptophlebia	*Baetis*
Plecoptera	*Drunella doddsi*
Calineuria	Plecoptera
Hesperoperla	*Isoperla*
Taenionema	*Nemoura*
Trichoptera	*Perlomyia*
Rhyacophila #1	Trichoptera
Diptera	*Ceratopsyche*
Simuliidae	*Hydropsyche*
	Rhyacophila #2
	Diptera
	Chironomidae (Pupa)
	Dicrarwta
	Antocha
	Bezzia
	Gastropoda
	Juga
	Pelecypoda
	Pisidium
	Coleoptera
	Zaitzevia
	Cleptelmis
	Optioservus
	Decapoda
	Pacifasticus leniusculus
	Odonata
	Gomphus

TWINSPAN - **WINTER 1991** BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Columbia Basin

Frequently Present (3-6 Sites)

Ephemeroptera
- ***Baetis***

Trichoptera
- ***Hydropsyche***

Diptera
- ***Antocha***

Occasionally Present (1-2 Sites)

Ephemeroptera
- *Paraleptophlebia*

Plecoptera
- *Calineuria*
- *Isoperla*
- ***Nemoura***
- ***Hesperoperla***
- ***Zapada***
- ***Pteronarcys***
- ***Doroneuria***

Trichoptera
- ***Arctopsyche***
- ***Ceratopsyche***
- ***Rhyacophila*** #1
- *Moselyana*

Diptera
- Chi:ronomidae (Pupa)
- Simuliidae
- ***Dicranota***
- *Tabanus*
- *Glutops*
- ***Antocha***

Megaloptera
- *Sialis*

Coleoptera
- ***Zaitzevia***
- ***Psephenus***
- ***Lara***
- ***Optioservus***

Amphipoda
- *Hyalella azteca*

TWINSPAN - **WINTER 1991** BENTHIC MACROINVERTEBRATFS

REGIONAL OCCURRENCE FREQIJENCIES

Cascades

Frequently Present (3-6 Sites)

Plecoptera
- *Taenionema*
- *Sweltsa*

Trichoptera
- ***Rhyacophila*** *#2*
- ***Moselyana***

Occasionally Present (1-2 Sites)

Ephemeroptera
- ***Ephemerella***
- *Eurylophella*
- *Drunella doddsi*

Plecoptera
- ***Zap****ada*
- ***Doroneuria***
- *Perlomyia*
- *Malenka*
- ***Kathroperla***
- *Cultus*

Trichoptera
- ***Glossosoma***
- ***Arctopsyche***
- ***Brachycentrus***

Diptera
- *Atherix*

TWINSPAN - WINTER 1991 BENTHIC MACROINVERTEBRATES

TAXA WITH DISTRIBUTION AMONG ALL ECOREGIONS

Frequently Present (3-6 Sites)

Ephemeroptera
- *Cinygmula* #1

Diptera
- Chironomidae

Occasionally Present (1-2 Sites)

Ephemeroptera
- *Serratella*
- *Epeorus*
- *Rithrogena*

Plecoptera
- *Sweltsa*

Diptera
- *Hexatoma*

Oligochaeta
- Lumbriculidae

Note: "Frequently Present" taxa appeared at 3-6 sites within each of the three ecoregions. "Occasionally Present" taxa appeared at 1-2 sites within each of the three ecoregions during the season.

TWINSPAN - **SPRING 1991** BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Puget Lowlands

<u>Frequently Present</u> (3-6 Sites)

Ephemeroptera
- *Paraleptophlebia*

Plecoptera
- *Haploperla*

Trichoptera
- *Rhyacophila* #2

<u>Occasionally Present</u> (l-2. Sites)

Ephemeroptera
- *Amaletus*

Plecoptera
- *Zapada*

Trichoptera
- *Rhyacophila* (Pupa)
- *Polycentropus*

Diptera
- *Bezzia*
- *Dicranota*
- Simuliidae
- *Chelifera*

Coleoptera
- *Cleptelmis*

Gastropoda
- *Jugus*

TWINSPAN - SPRING 1991 BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Columbia Basin

<u>Frequently Present</u> (3-6 Sites)

Ephemeroptera
- ***Paraleptophlcbia***

Trichoptera
- *Hydropsyche*

Diptera
- Chironomidae (Pupa)
- ***Antocha***

<u>Occasionally Present</u> (1-2 Sites)

Ephemeroptera
- ***Cinygmula*** #2
- *Eurylophella*
- ***Rithrogena***
- ***Ephemerella***

Plecoptera
- *Cultus*
- *Taenionema*
- *Sweltsa*
- ***Claassenia***
- ***Hesperoperla***
- *Zapada*
- ***Podmosta***

Trichoptera
- *Amiocentrus*
- ***Cheumatopsyche***
- ***Parapsyche***
- ***Rhyacophila*** #1
- ***Micrasema***
- ***Dicosmoecus***

Diptera
- ***Clinocera***
- ***Pericoma***
- ***Bezzia***
- Tipulidae (Pupa)
- Simuliidae

Coleoptera
- *Psephenus*
- ***Stenelmis***
- *Optioservus*
- ***Heterlimnius***

Oligochaeta
- Naididae
- ***Rhynchelmis***

TWINSPAN - SPRING 1991 BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Cascades

<u>Frequently Present</u> (3-6 Sites)

Ephemeroptera
- ***Drunella*** *doddsi*
- *Drunella spinifera*
- ***Rithrogena***

Plecoptera
- ***Haploperla***

Trichoptera
- ***Rhyacophila*** #1
- ***Rhyacophila*** #2

<u>Occasionally Present</u> (l-2 Sites)

Ephemeroptera
- ***Taenionema***
- *Eurylophella*
- *Attenella*
- ***Drunella*** *coloradensis*
- *Amaletus*
- ***Ephemerella***

Plecopterii
- ***Sweltsa***
- *Skwala*
- *Pteronarcys*

Trichoptera
- Limnephilidae (Pupa)
- ***Pedomoecus***
- ***Brachycentrus***
- ***Hydropsyche***
- ***Micrasema***

Diptera
- Simuliidae (Pupa)
- ***Molophilus***
- ***Oreogeton***
- ***Pericoma***
- *Atherix*
- *Tabanus*

Coleoptera
- ***Cleptelmis***
- *Optioservus*
- *Stenelmis*

Acari
- Hydracarina

Lepidoptera
- Pyralidae

Turbellaria
- Planariidae

TWINSPAN - SPRING 1991 BENTHIC MACROINVERTEBRATES

TAXA WITH DISTRIBUTION AMONG ALL ECOREGIONS

Frequently Present (3-6 Sites)	Occasionally Present (1-2 Sites)
	Ephemeroptera
	Serratella
	Cinygmula #1
	Epeorus
	Baetis
	Plecoptera
	Isoperla
	Calineuria
	Diptera
	Hexatoma
	Chironomidae
	Oligochaeta
	Lumbriculidae

Note: "Frequently Present" taxa appeared at 3-6 sites within each of the three ecoregions. "Occasionally Present" taxa appeared at 1-2 sites within each of the three ecoregions during the season.

TWINSPAN - SUMMER 1991 BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Puget Lowlands

Frequently Present (3-6 Sites)	Occasionally Present (1-2 Sites)
	Ephemeroptera
	Paraleptophlebia bicornuta
	Cinygmula #2
	Plecoptera
	Hesperoperla
	Calineuria
	Amphinemura
	Trichoptera
	Lepidostoma
	Apatania
	Hydropsyche
	Rhyacophila #2
	Rhyacophila (Pupa)
	Diptera
	Atherix
	Tabanus
	Megaloptera
	Sialis
	Coleoptera
	Cleptelmis
	Heterlimnius
	Optioservus (Adult)
	Hydrophilidae
	Decapoda
	Pacifasticus leniusculus

TWINSPAN - SUMMER 1991 BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Columbia Basin

Frequently Present (3-6 Sites)

Plecoptera
- Skwala

Occasionally Present (l-2 Sites)

Ephemeroptera
- *Paraleptophlebia bicornuta*
- *Heptagenia*
- *Eurylophella*
- *Cinygmula #2*

Plecoptera
- *Amphinemura*
- *Pteronarcella*
- *Sweltsa*
- *Soliperla*
- *Perlomyia*
- *Hesperoperla*
- *Doroneuria*

Trichoptera
- *Brachycentrus*
- *Cheumatopsyche*
- *Clostoeca*
- *Lepidostoma*
- *Dicosmoecus*
- *Glossosoma*
- *Glossosoma* (Pupa)
- *Rhyacophila #1*
- *Micrasema*

Megaloptera
- *Sialis*

Diptera
- *Agathon*
- *Atherix*
- Chironomidae (Pupa)
- *Antocha*

Coleoptera
- *Donacia* (Adult)
- *Optioservus* (Pupa)
- *Psephenus*
- *Cleptelmis*
- *Heterlimnius*
- *Heterlimnius* (Adult)

TWINSPAN **SUMMER 1991** BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Columbia Basin (Continued)

Occasionally Present (1-2 sites)

Coleoptera
- *Optioservus*
- *Optioservus* (Adult)

Decapoda
- *Pacifasticus leniusculus*

Oligochaeta
- Lumbriculidae

TWINSPAN - SUMMER 1991 BENTHIC MACROINVERTEBRATES

REGIONAL OCCURRENCE FREQUENCIES

Cascades

Frequently Present (3-6 Sites)

Occasionally Present (1-2 Sites)

Ephemeroptera
- *Drunella doddsi*
- *Drunella spinifera*
- *Drunella coloradensis*
- *Ephemerella*
- *Epeorus*
- *Rithrogena*

Plecoptera
- *Cultus*
- *Neaviperla*
- *Calineuria*
- *Doroneuria*
- *Skwala*
- *Kathroperla*
- *Pteronarqs*

Trichoptera
- *Brachycentrus*
- *Hydropsyche*
- *Rhyacophila* #1
- *Rhyacophila* #2
- *Arctopsyche*

Diptera
- *Tipula*
- Chironomidae (Pupa)
- *Dicranota*

Oligochaeta
- *Rhynchelmis*

Turbellaria
- Planariidae

TWINSPAN - SUMMER 1991 BENTHIC MACROINVERTEBRATES

TAXA WITH DISTRIBUTION AMONG ALL ECOREGIONS

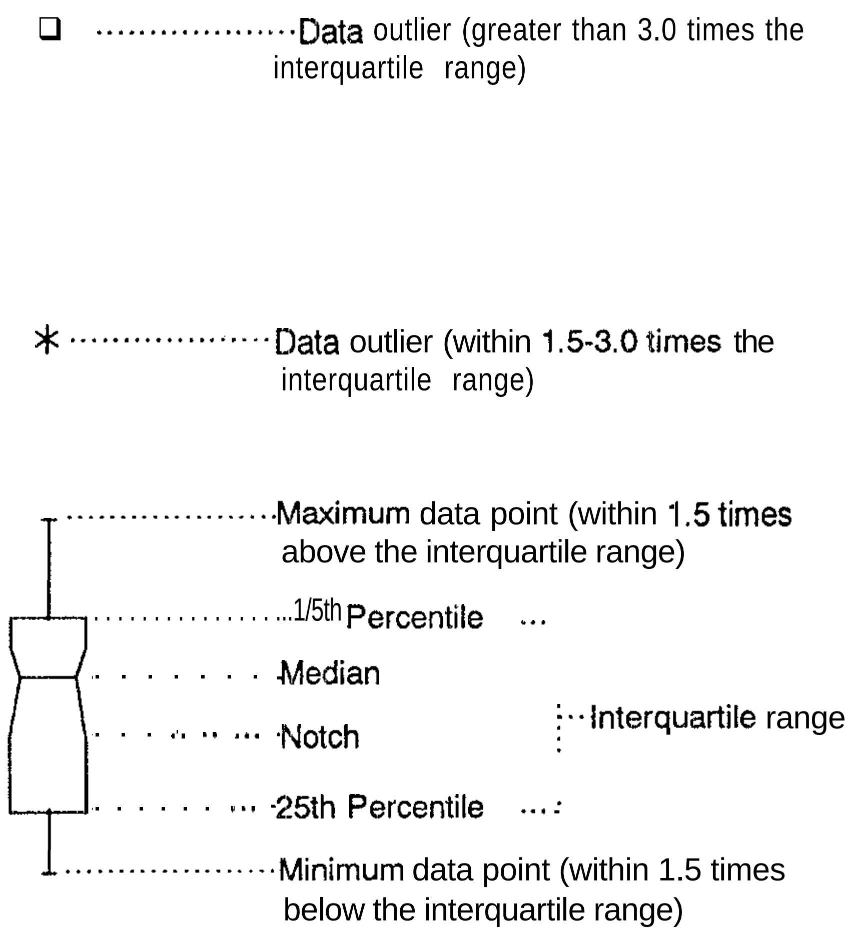
Frequently Present (3-6 Sites)	Occasionally Present (1-2 Sites)
	Ephemeroptera
	Paraleptophlebia sp.
	Cinygmula #1
	Baetis
	Plecoptera
	Yoroperla
	Trichoptera
	Polycentropus
	Diptera
	Chironomidae
	Hexatoma
	Tipulidae (Pupa)
	Coleoptera
	Stenelmis
	Acari
	Hydracarina
	Oligochaeta
	Naididae

Note: "Frequently Present" taxa appeared at 3-6 sites within each of the three ecoregions. "Occaionally Present" taxa appeared at 1-2 sites within eahc of the three ecoregions during the season.

Appendix H

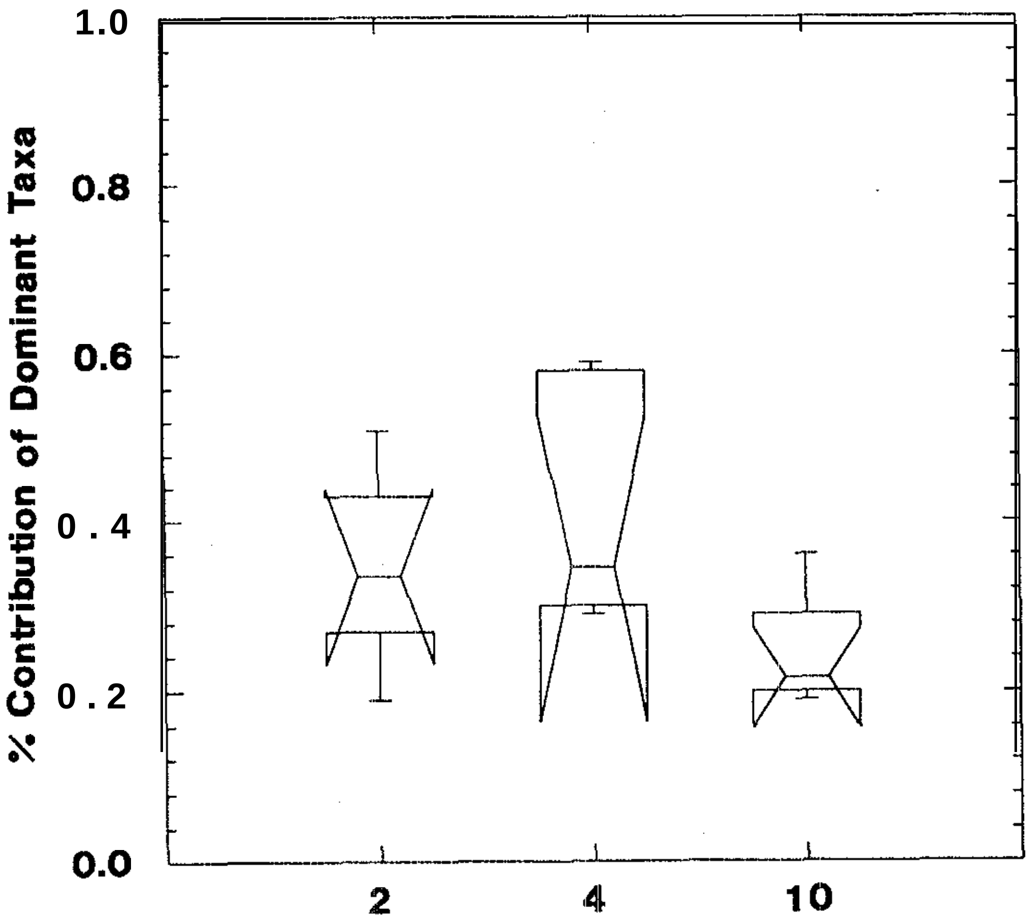
Rapid Bioassessment Protocol'111 Biometric Results
Seasonal Boxplot Figures

Box Plot Example



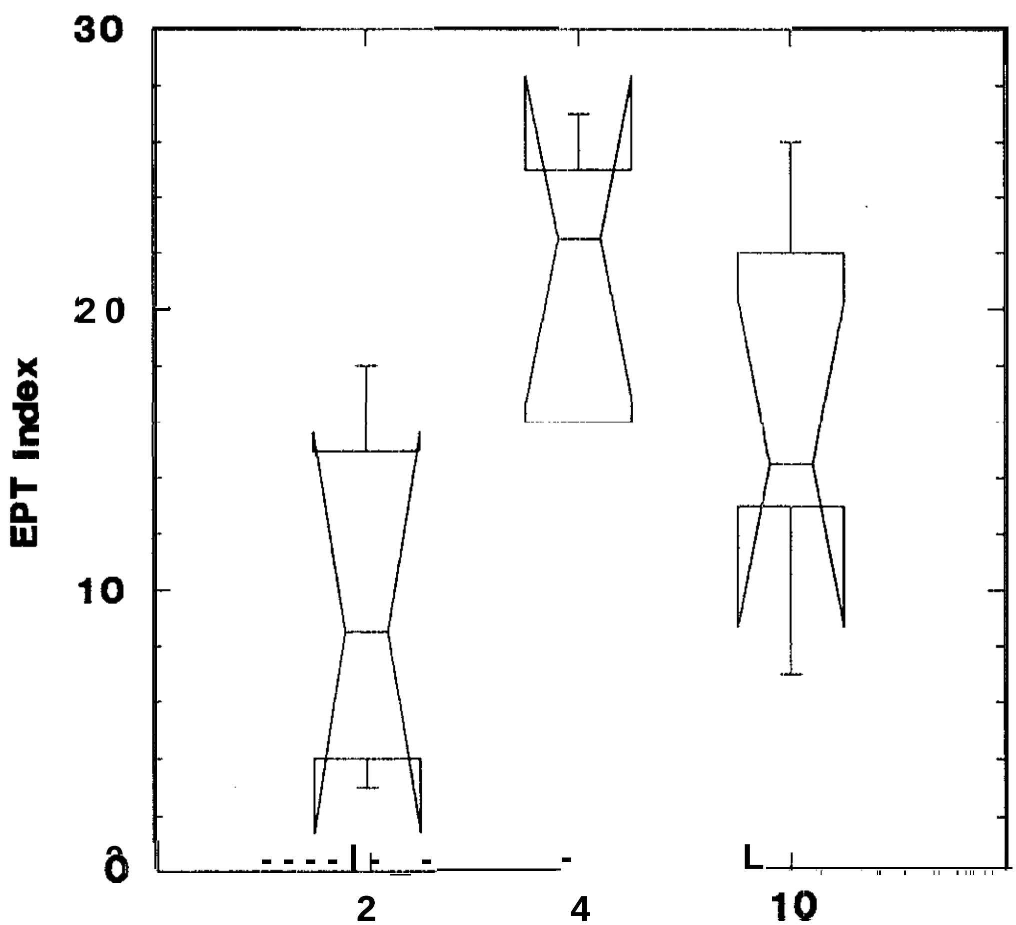
(notches in the box indicate 95% confidence intervals about the median)

Appendix H1. RBP III (Fall 1990)



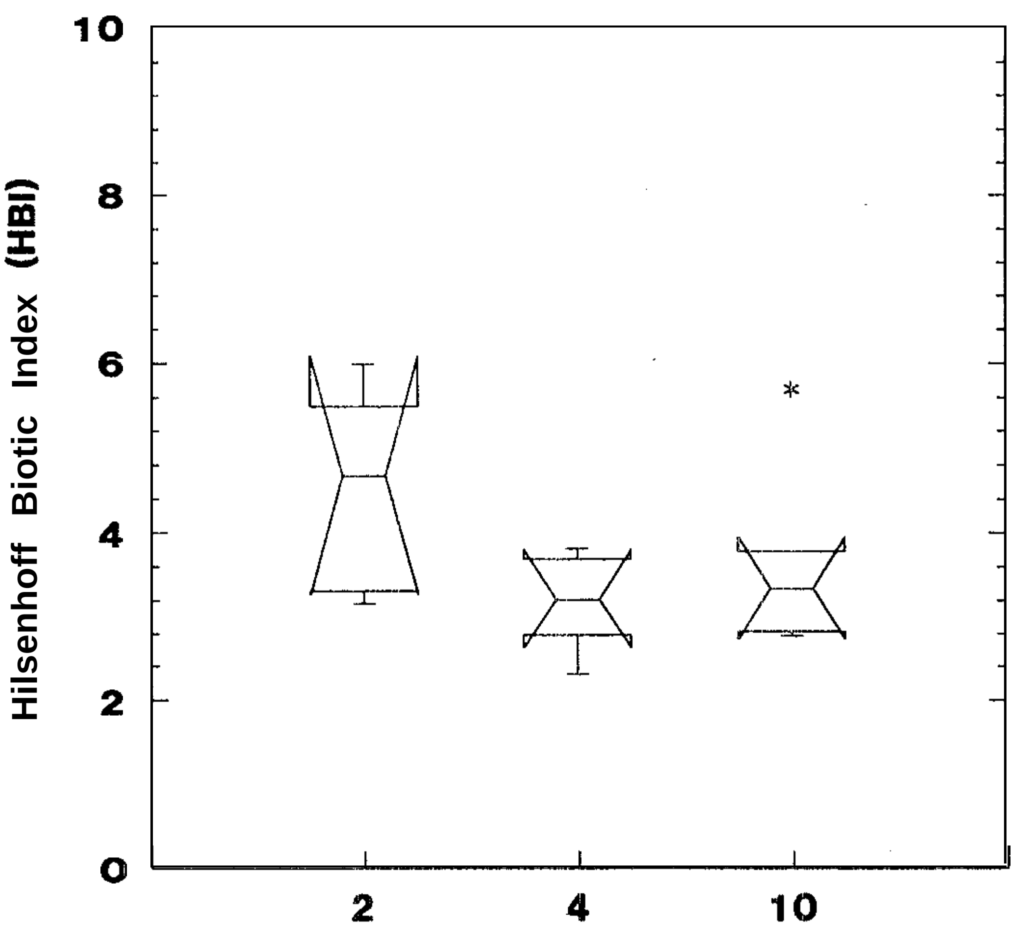
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H2. RBP III (Fall 1990)



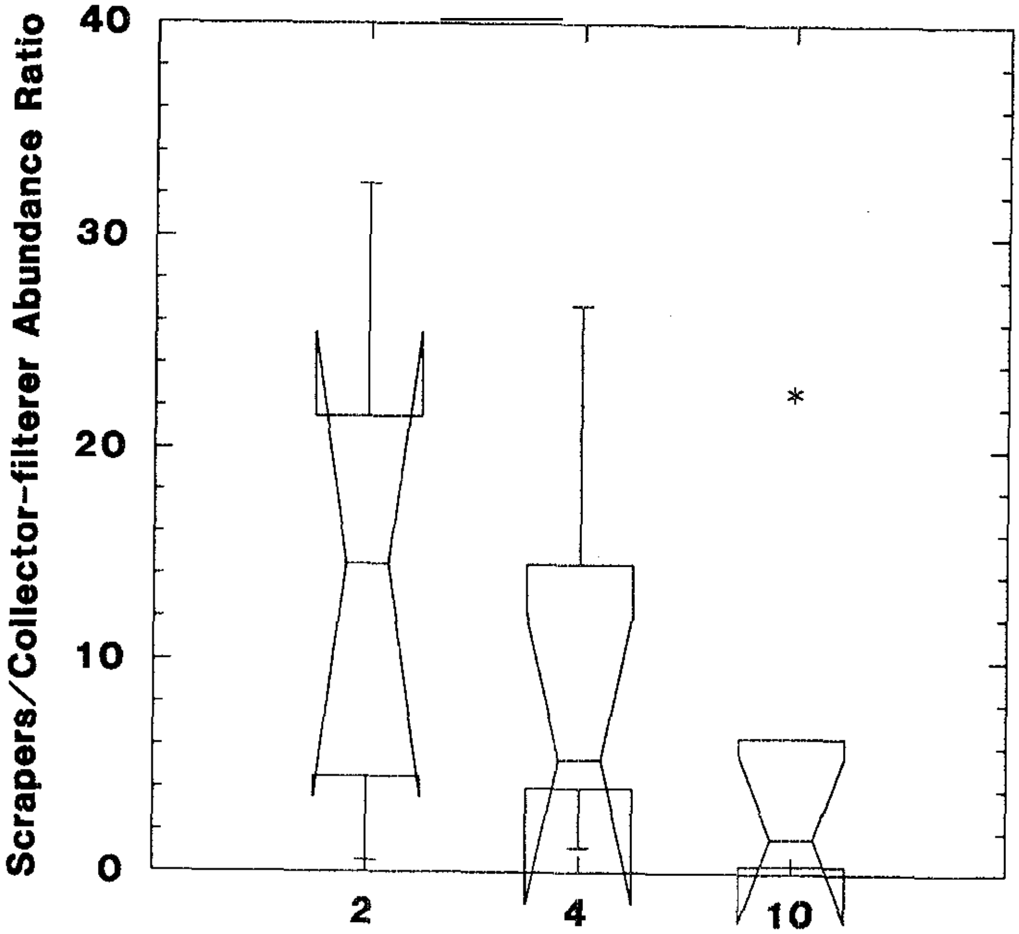
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

ppendix H3. RBP III (Fall 1990)



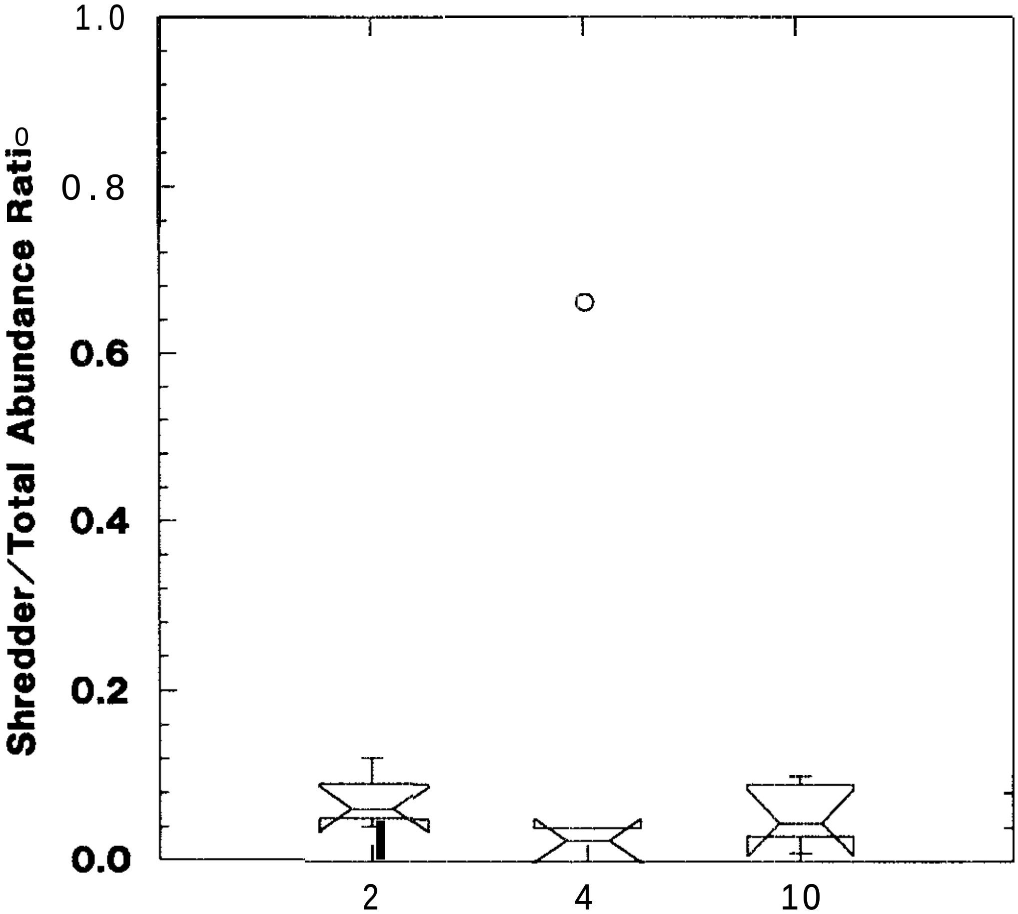
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H4. RBP III (Fall 1990)



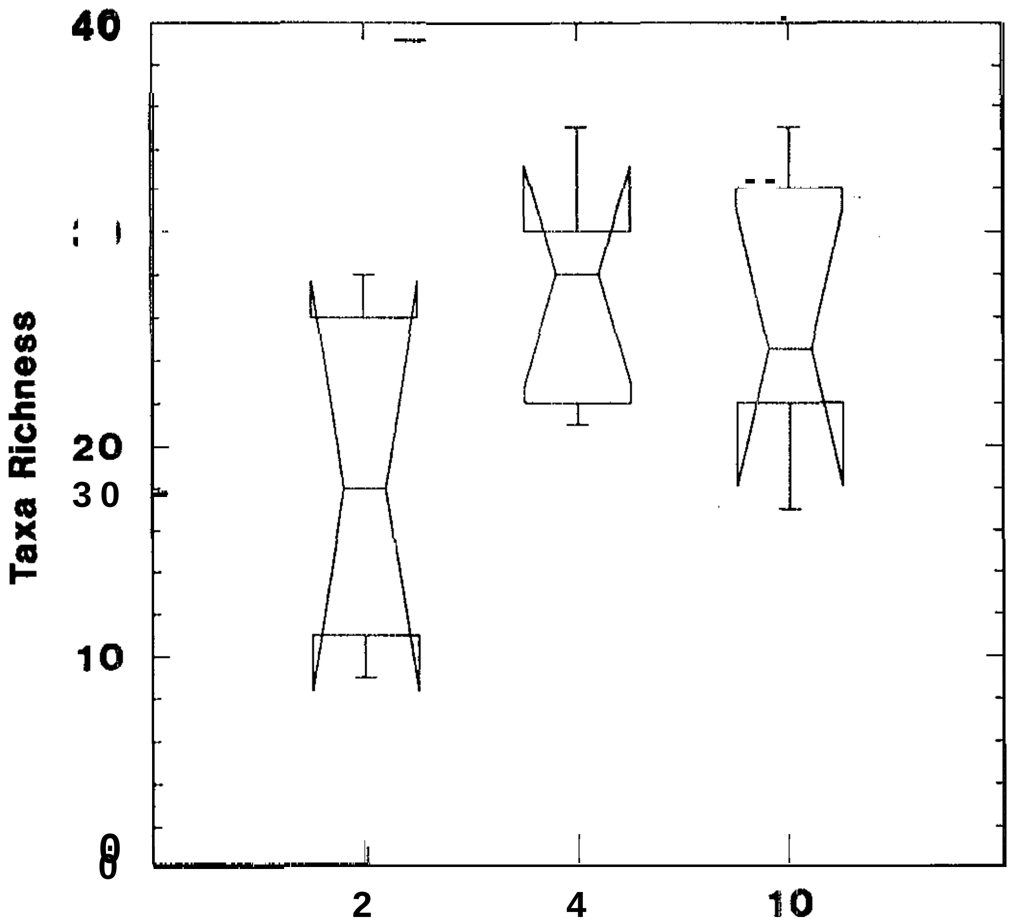
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H5. RBP III (Fall 1990)



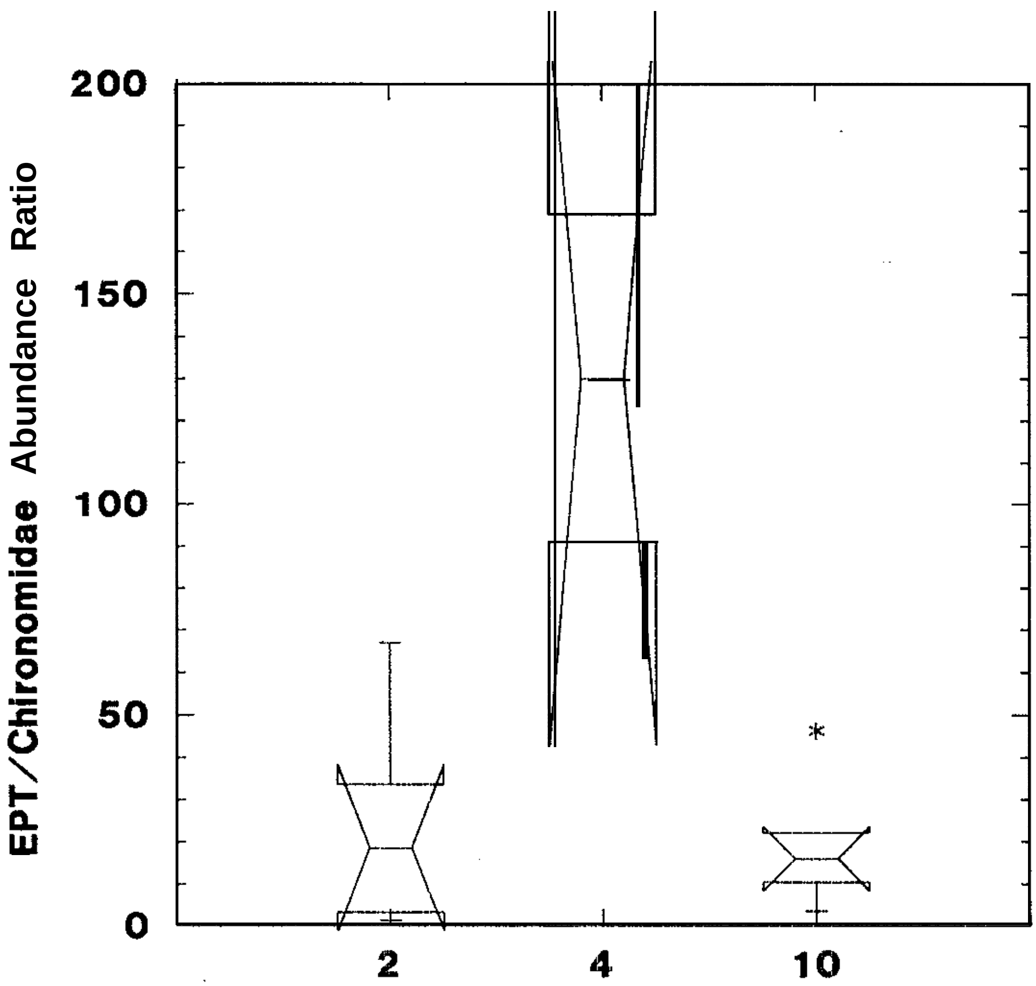
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H6. RBP III (Fall 1990)



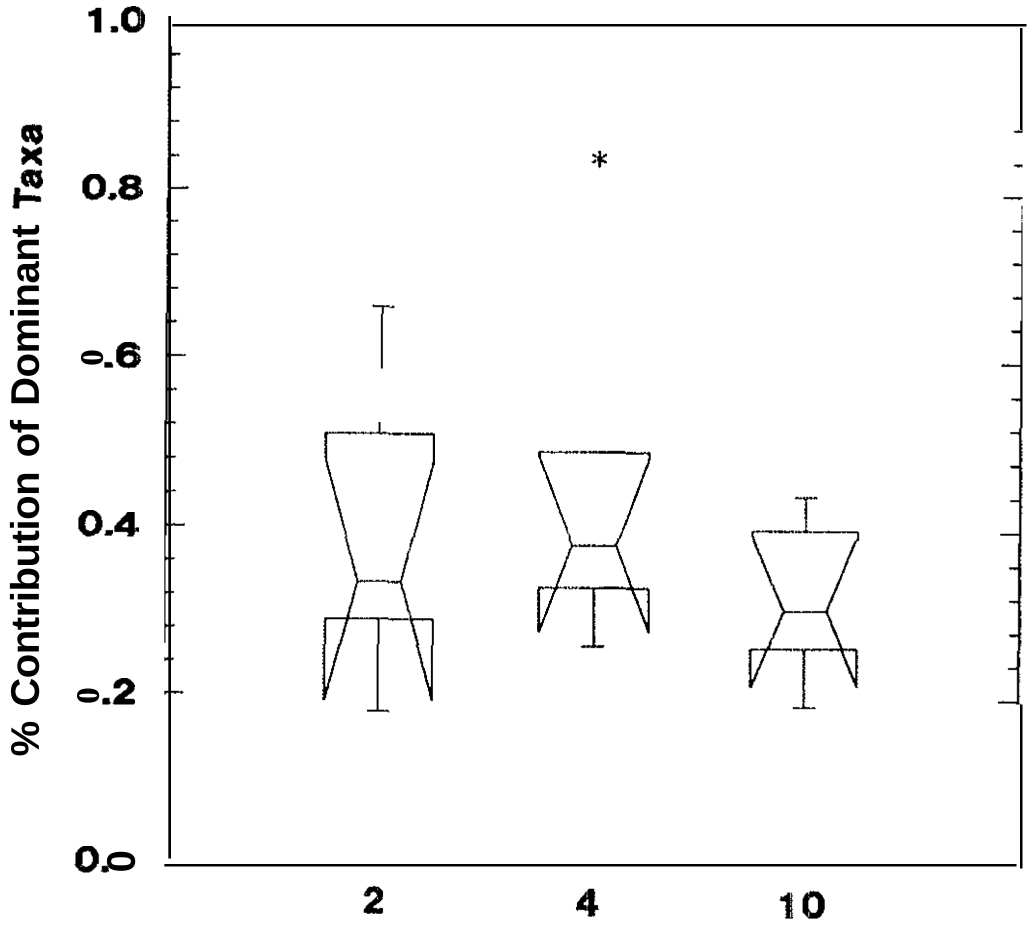
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H7. RBP II (Fall 1990)



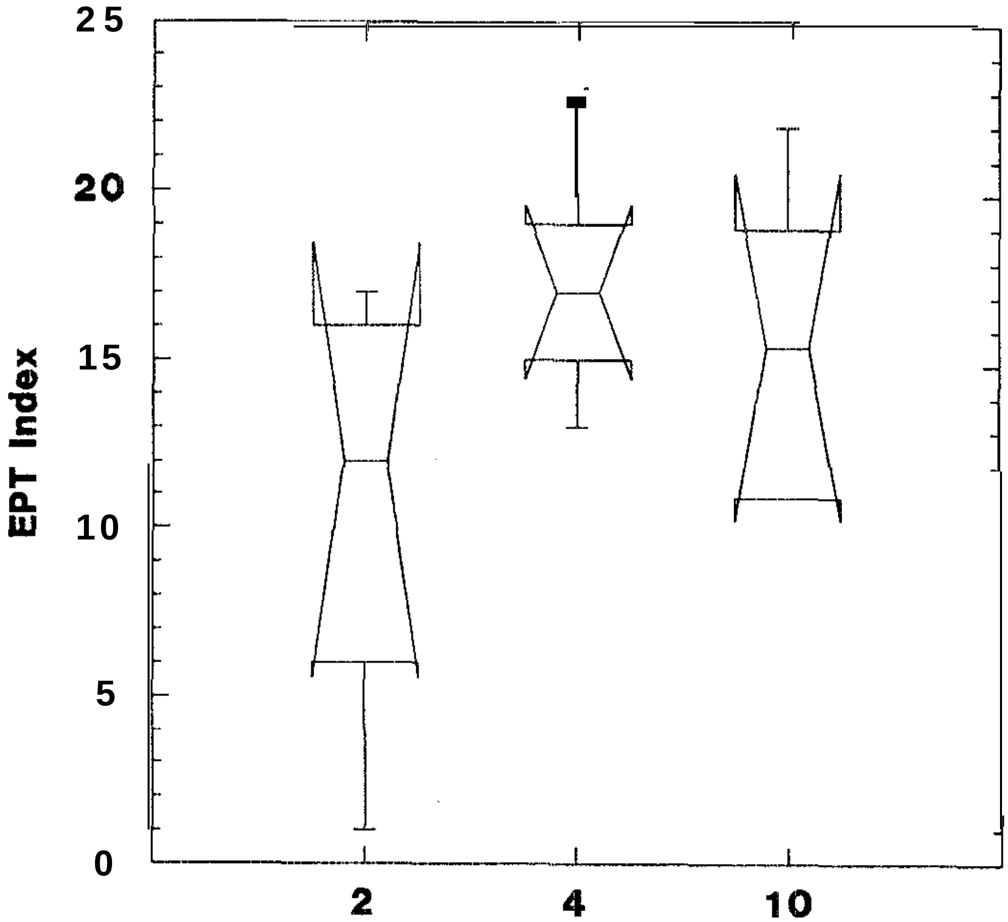
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H8. RBP III (Winter 1991)



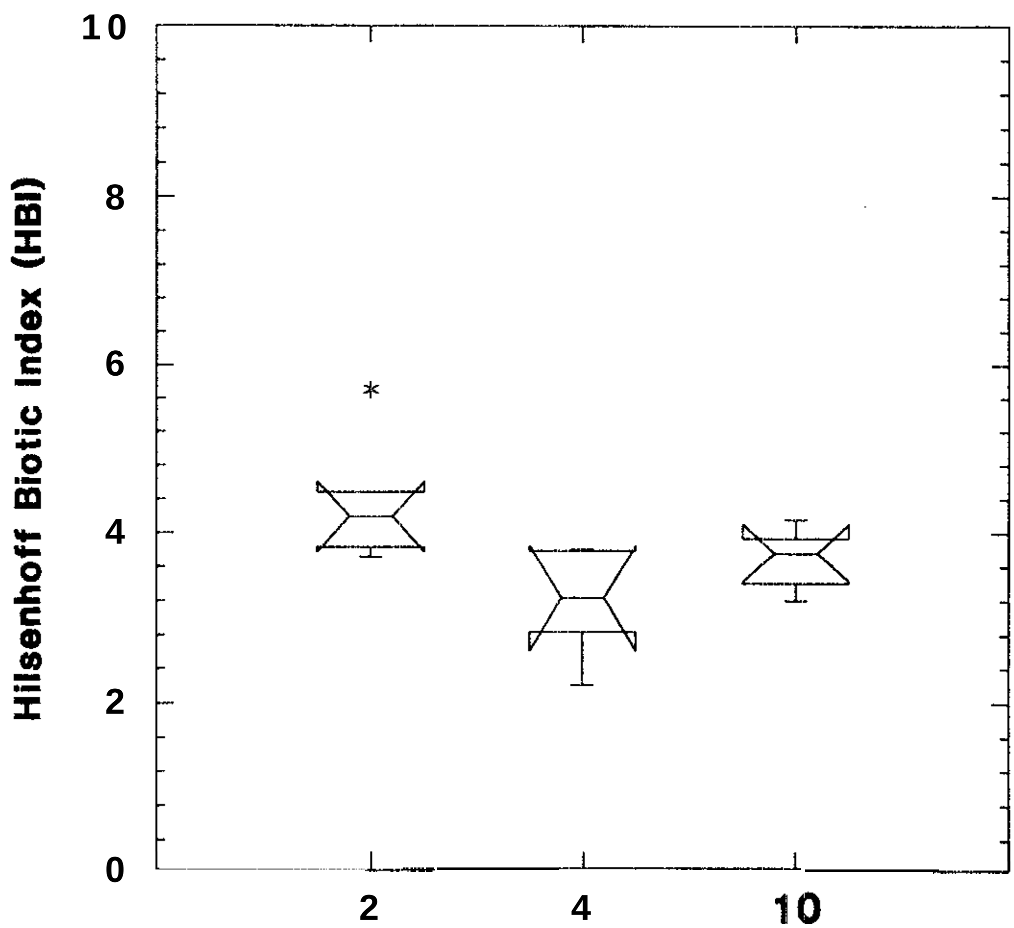
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H9. RBP III (Winter 1991)



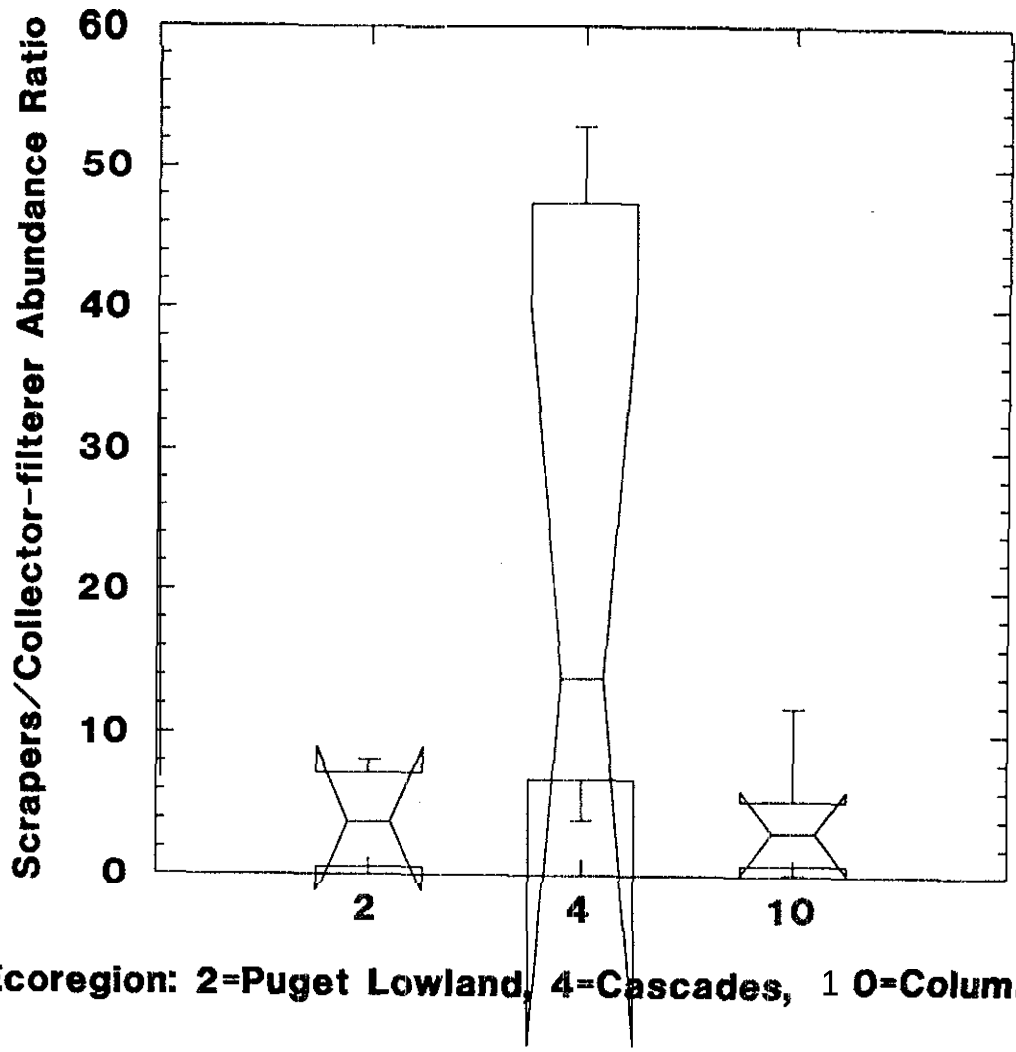
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H10. RBP III (Winter 1991)



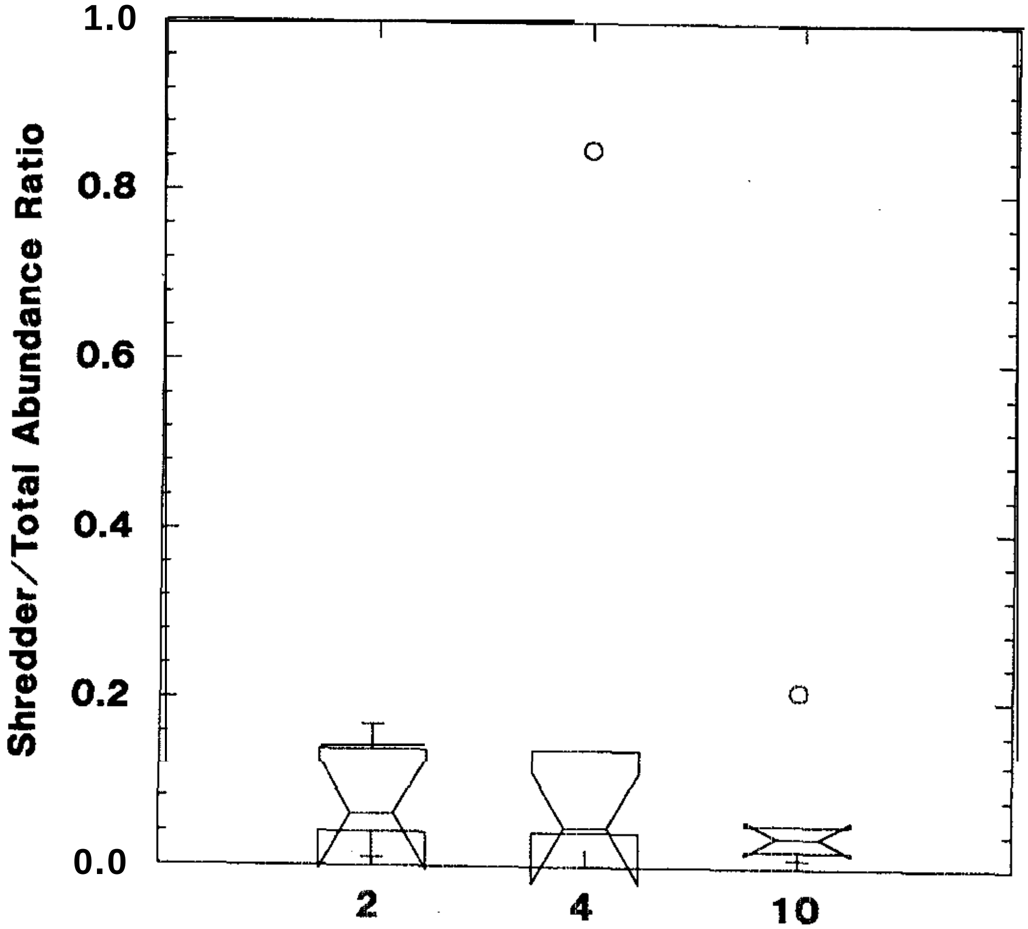
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H11 . RBP III (Winter 1991)



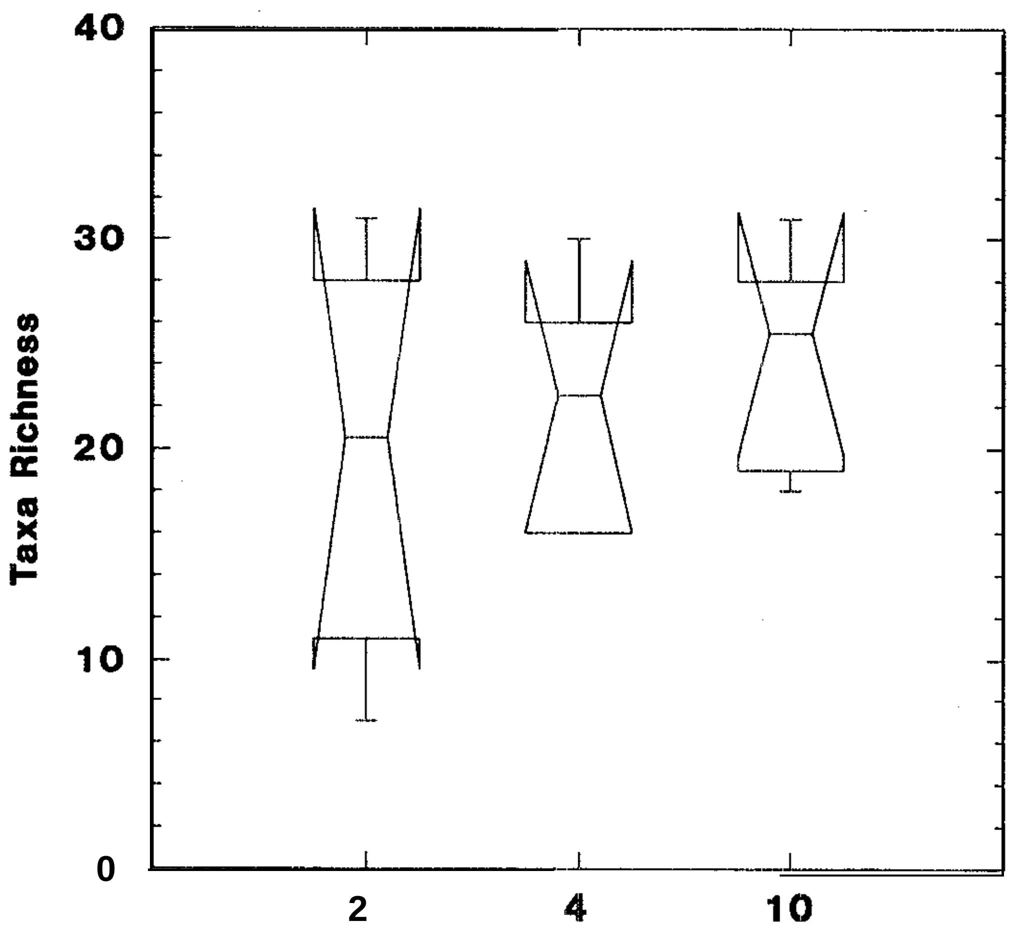
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H12. RBP III (Winter 1991)



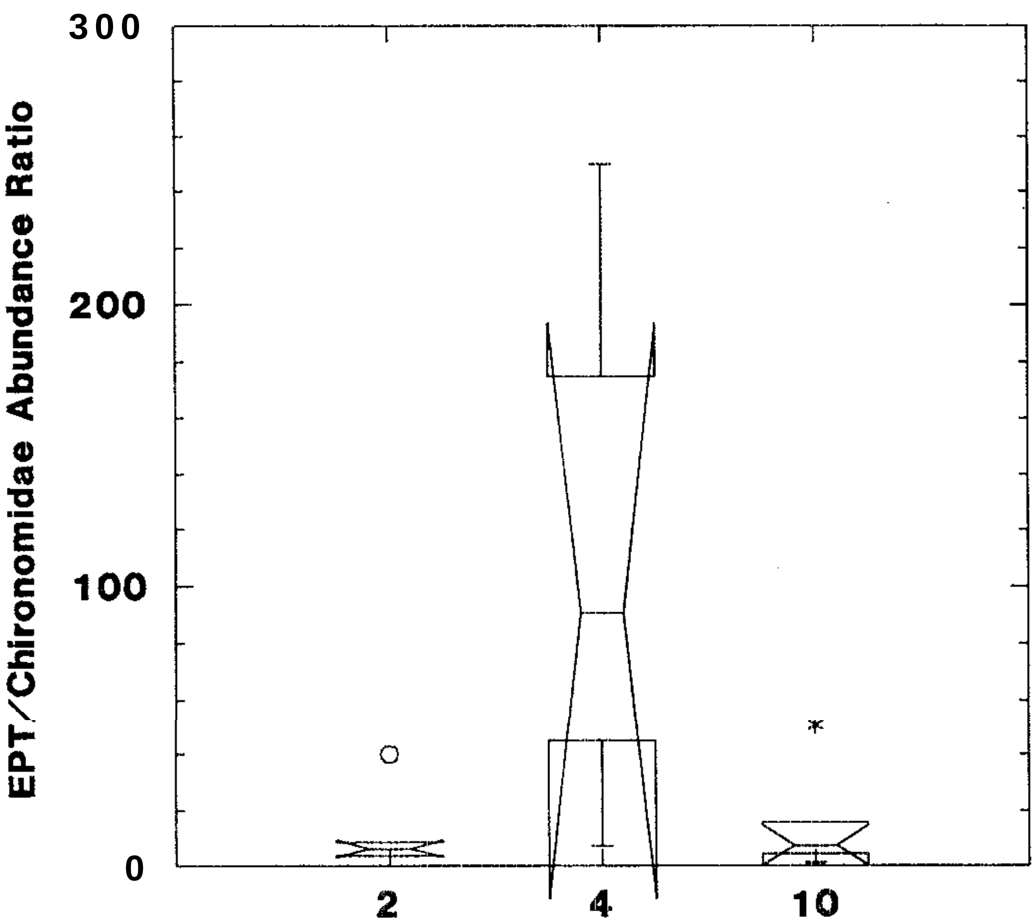
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H13. RBP III (Winter 1991)



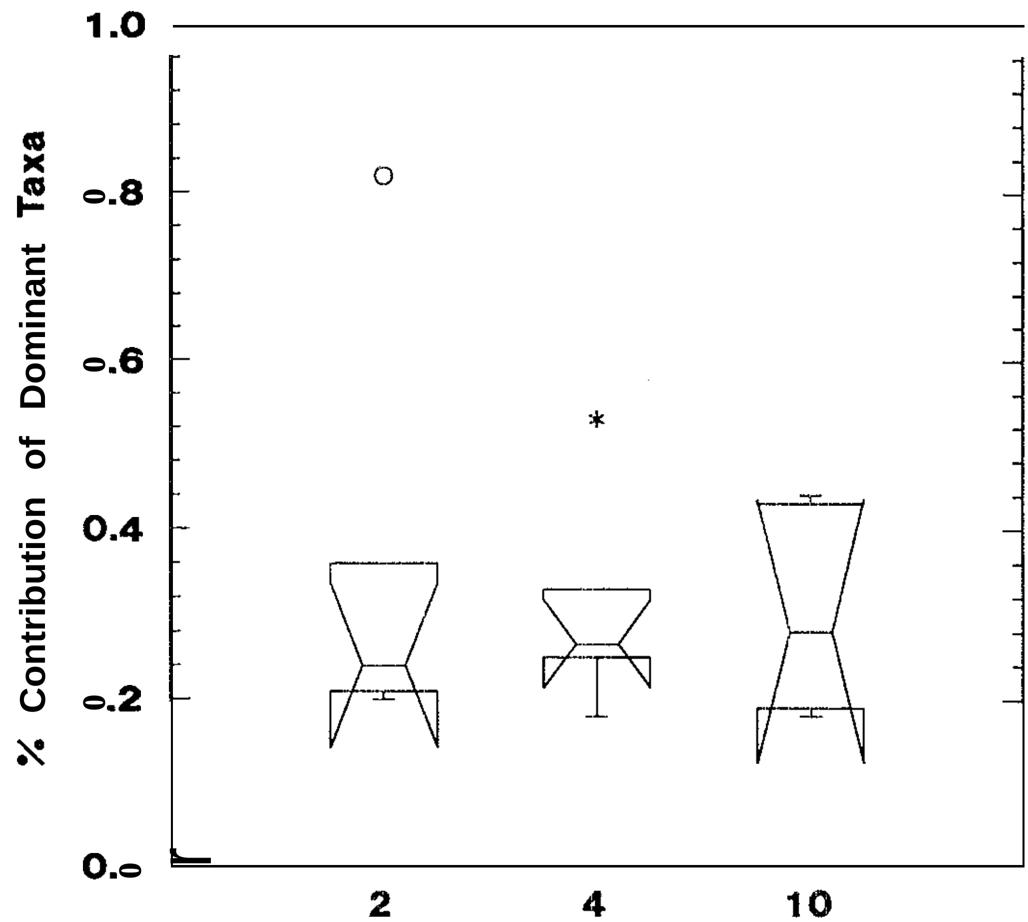
(Ecoregion: 2=Puget Lowland, &Cascades, 1 O-Columbia Basin)

Appendix HI 4. RBP III (Winter 1991)



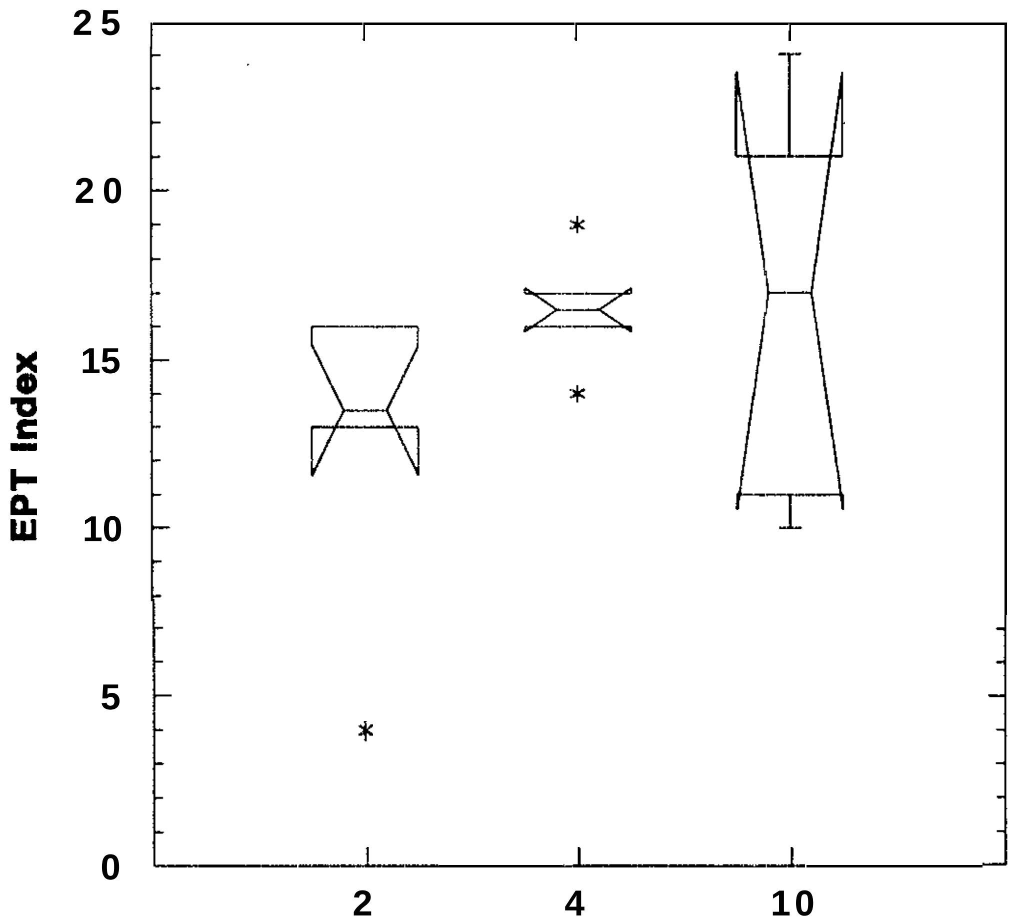
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H15. RBP III (Spring 1991)



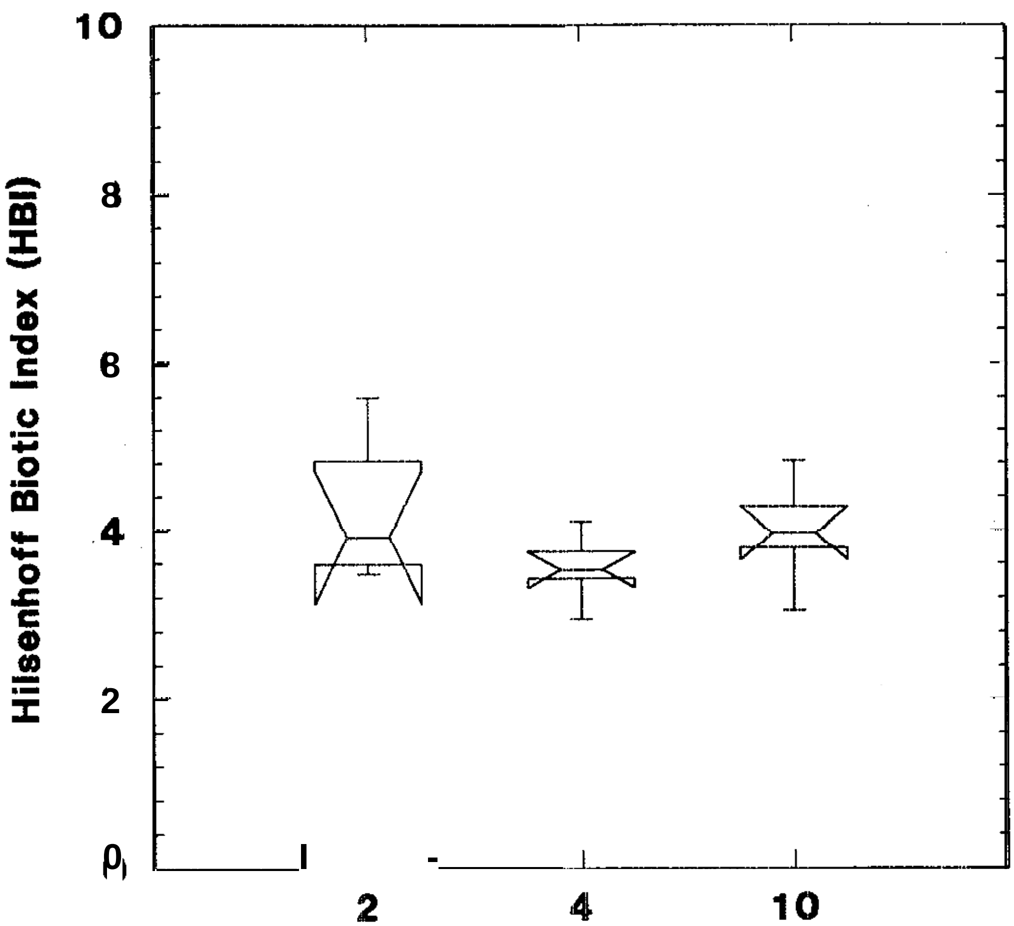
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix HI 6. RBP III (Spring 1991)



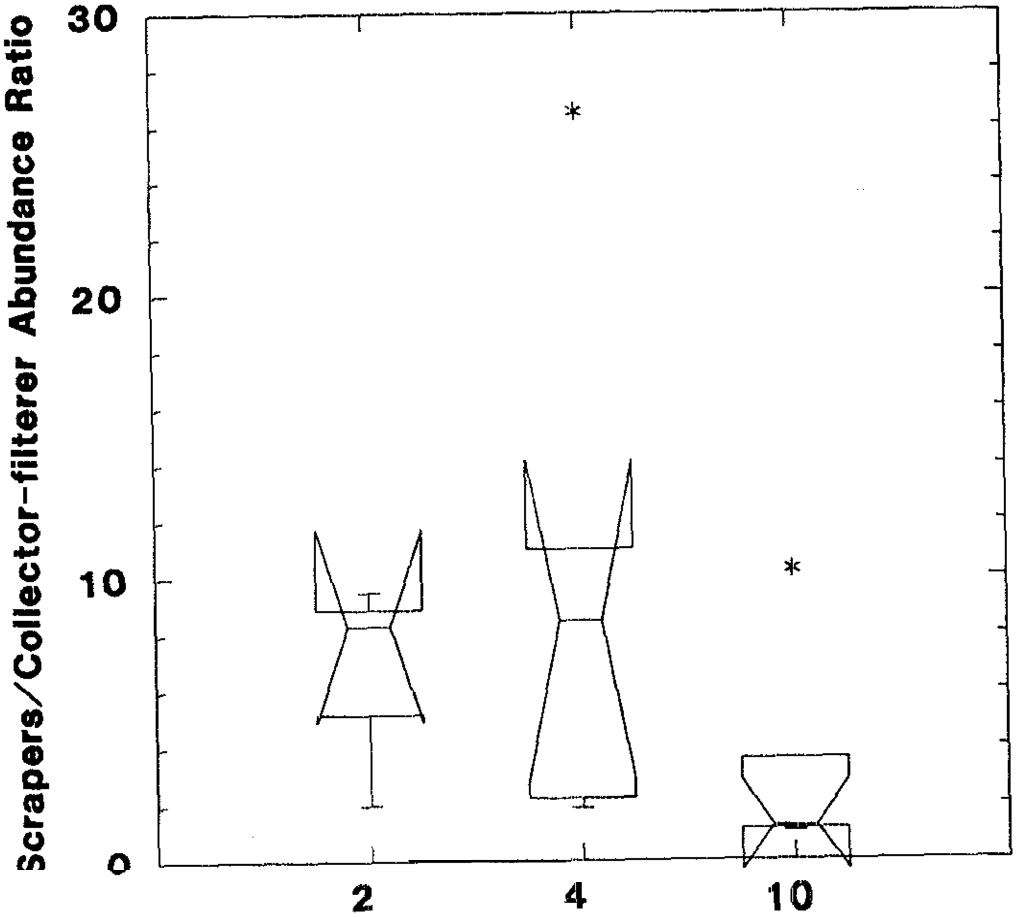
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix HI 7. RBP III (Spring 1991)



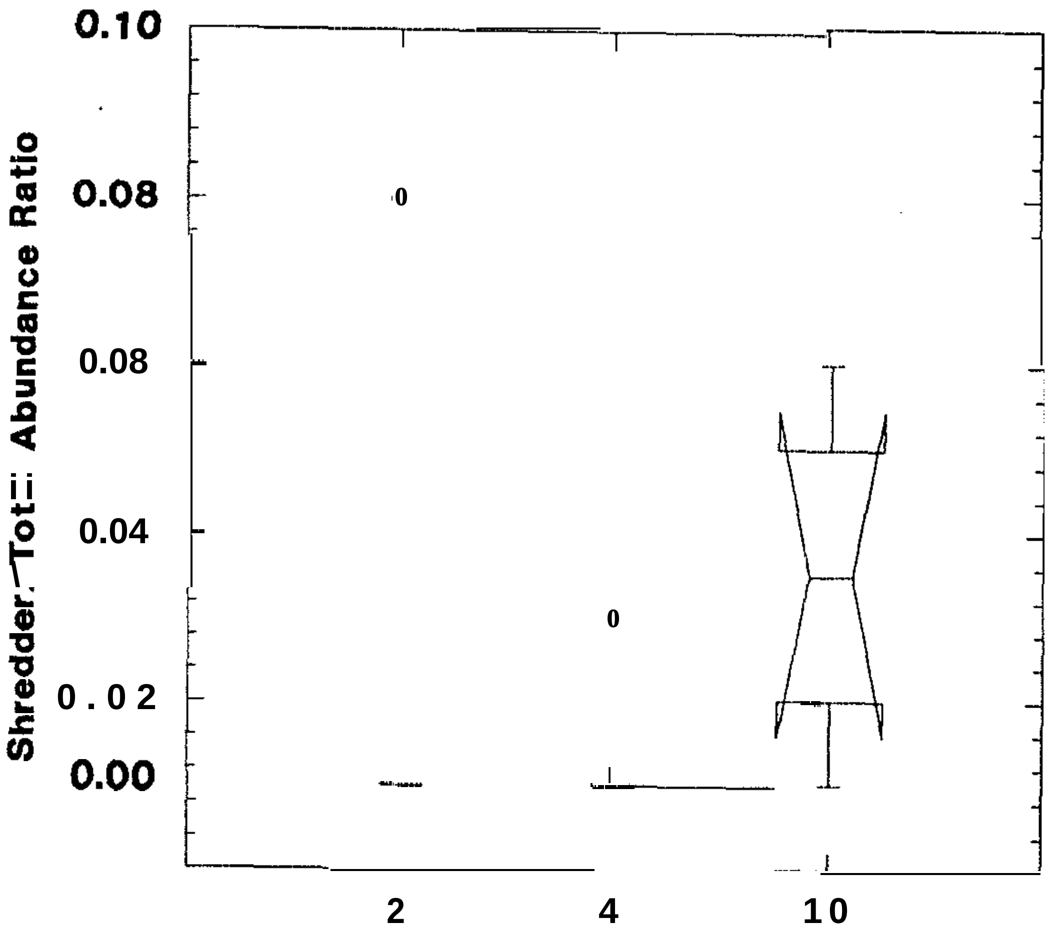
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H1 8. RBP III (Spring 1991)



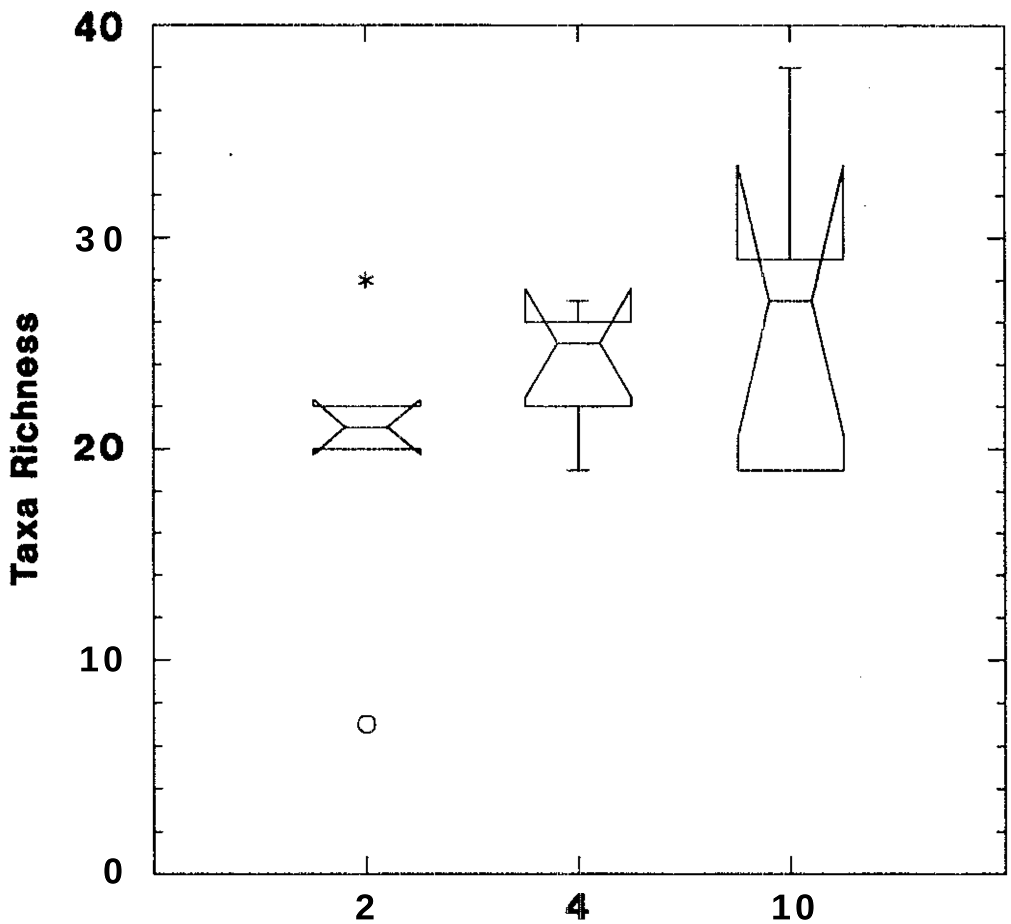
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H19. RBP III (Spring 1991)



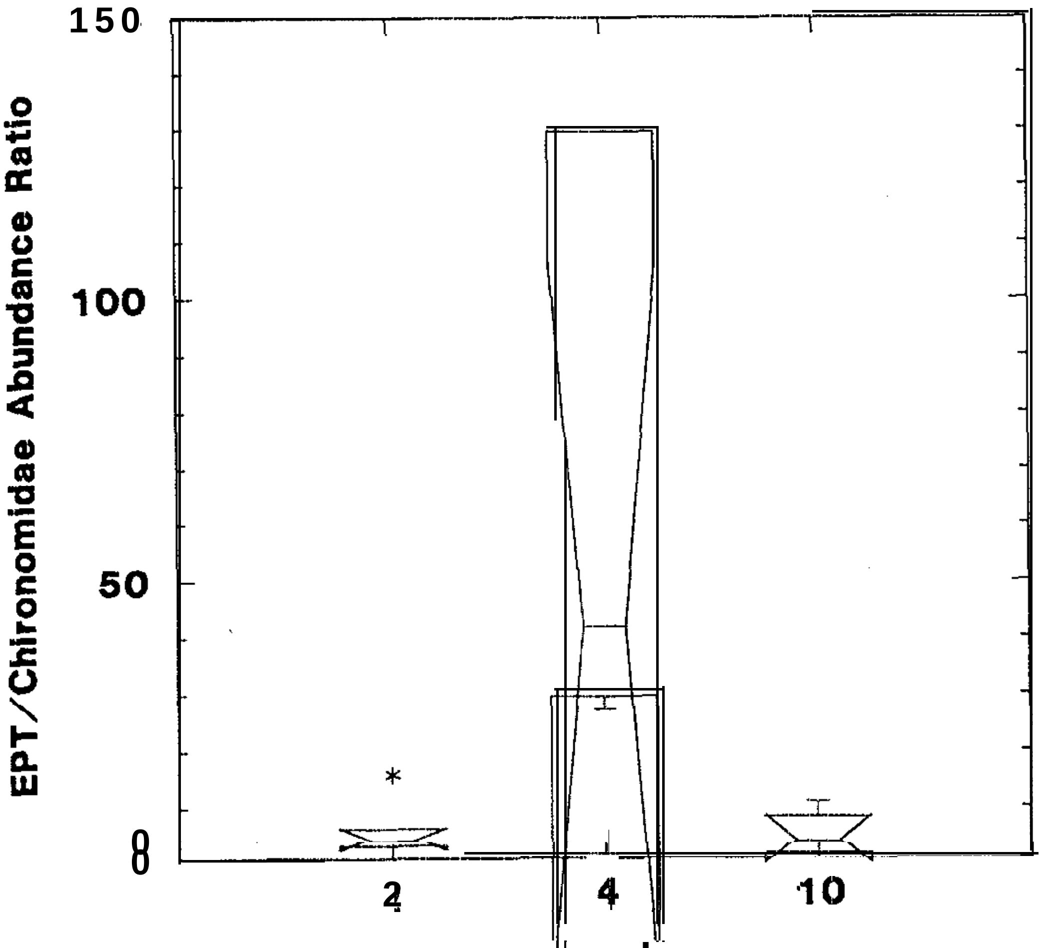
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H20. RBP III (Spring 1991)



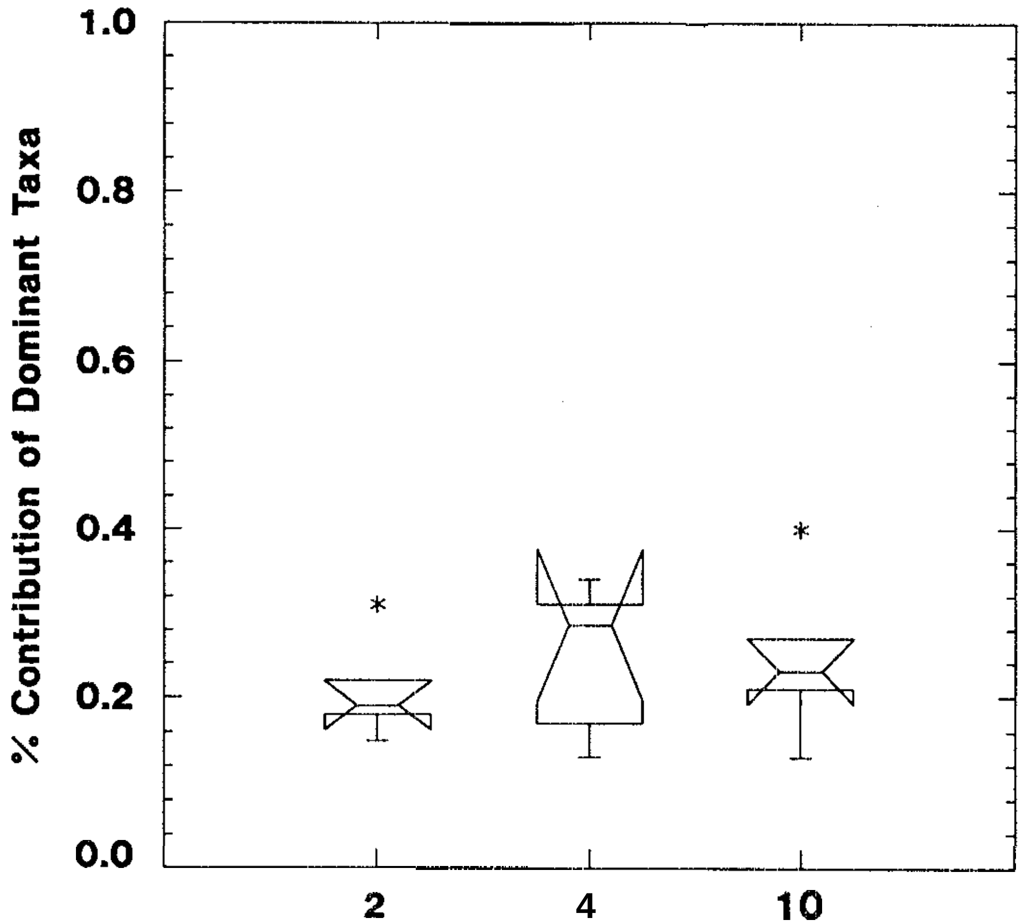
(Ecoregion: 2=Puget Lowland, &Cascades, 1 0=Columbia Basin)

Appendix H2 1. RBP III (Spring 1991)



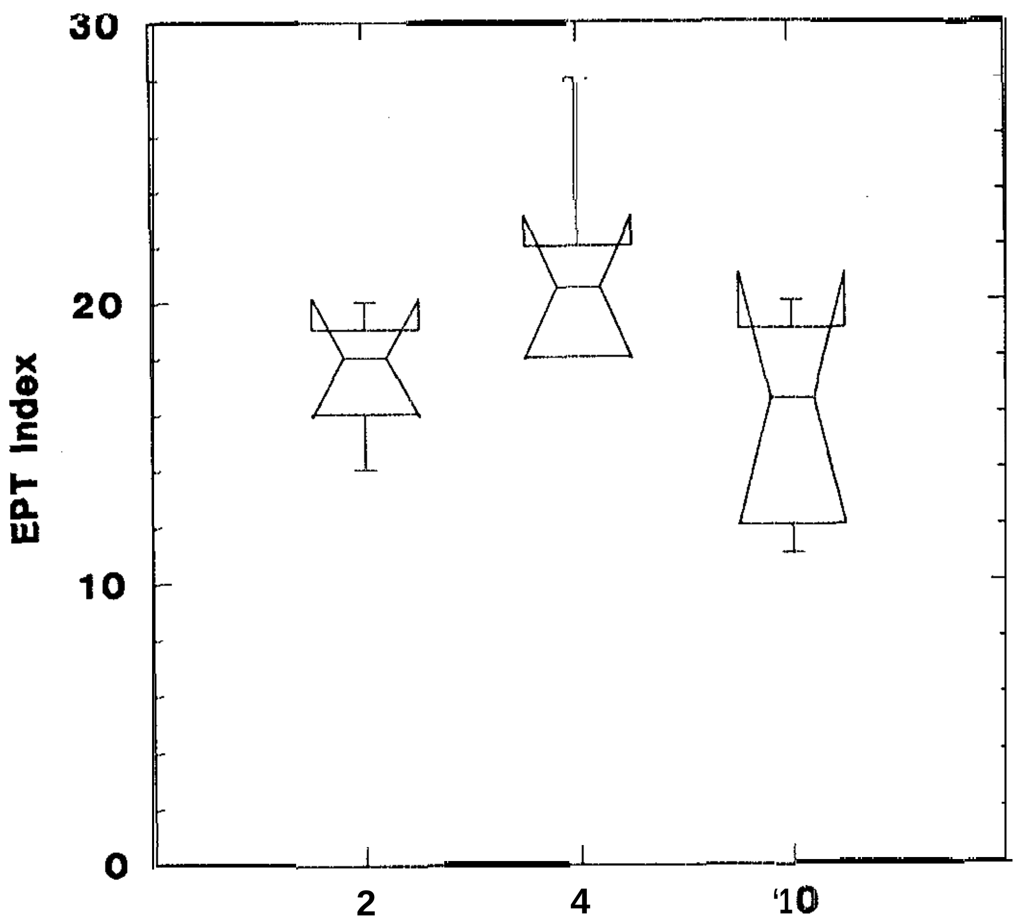
(Ecoregion: 2=Puget Lowland 4=Cascades, 10=Columbia Basin)

Appendix H22. RBP III (Summer 199 1)



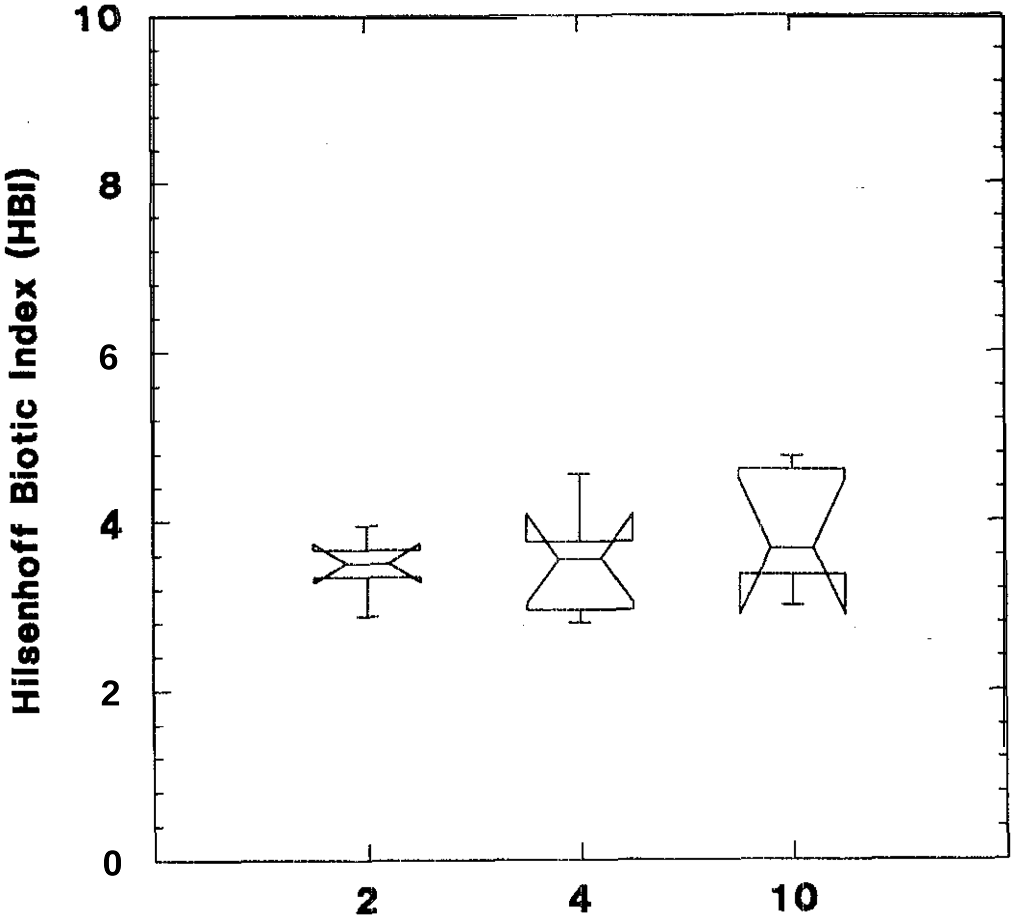
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H23. RBP III (Summer 1991)



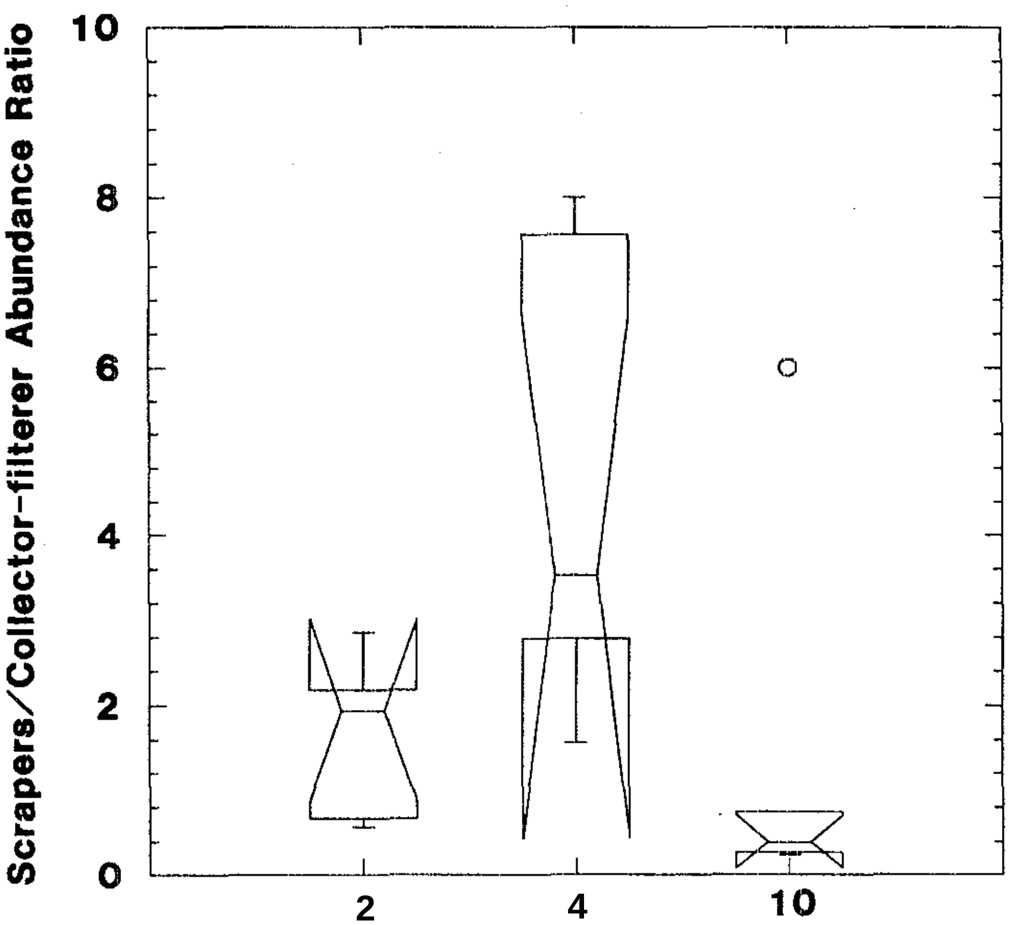
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H24. RBP III (Summer 1991)



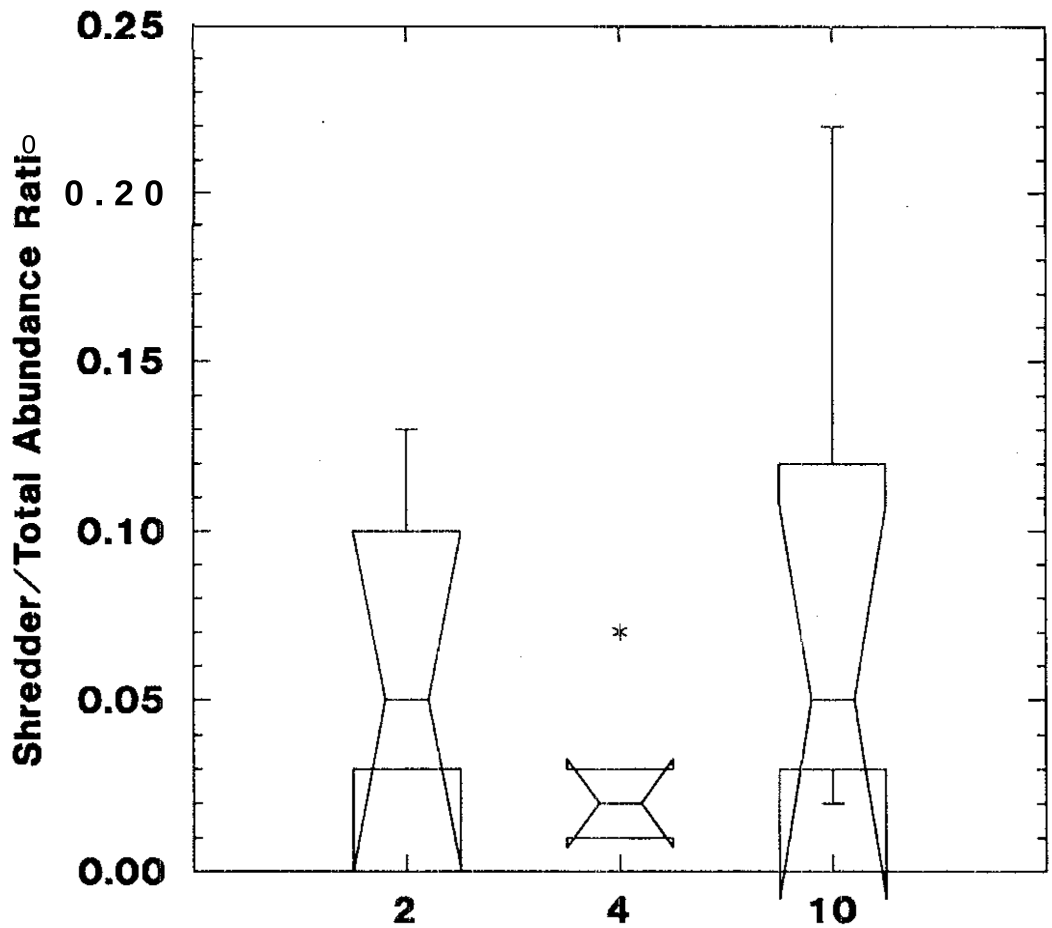
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix H25. RBP III (Summer 1991)



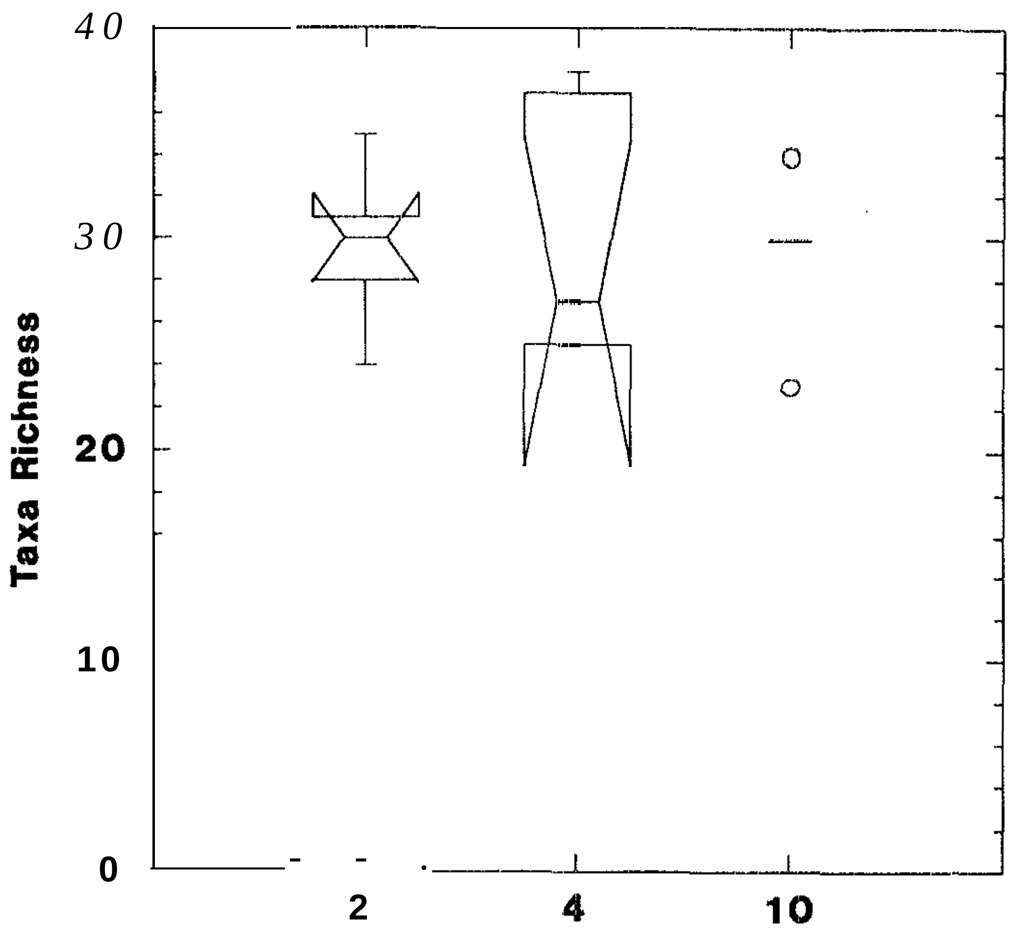
(Ecoregion: 2=Puget Lowland, &Cascades, 1 0=Columbia Basin)

Appendix H26. RBP III (Summer 1991)



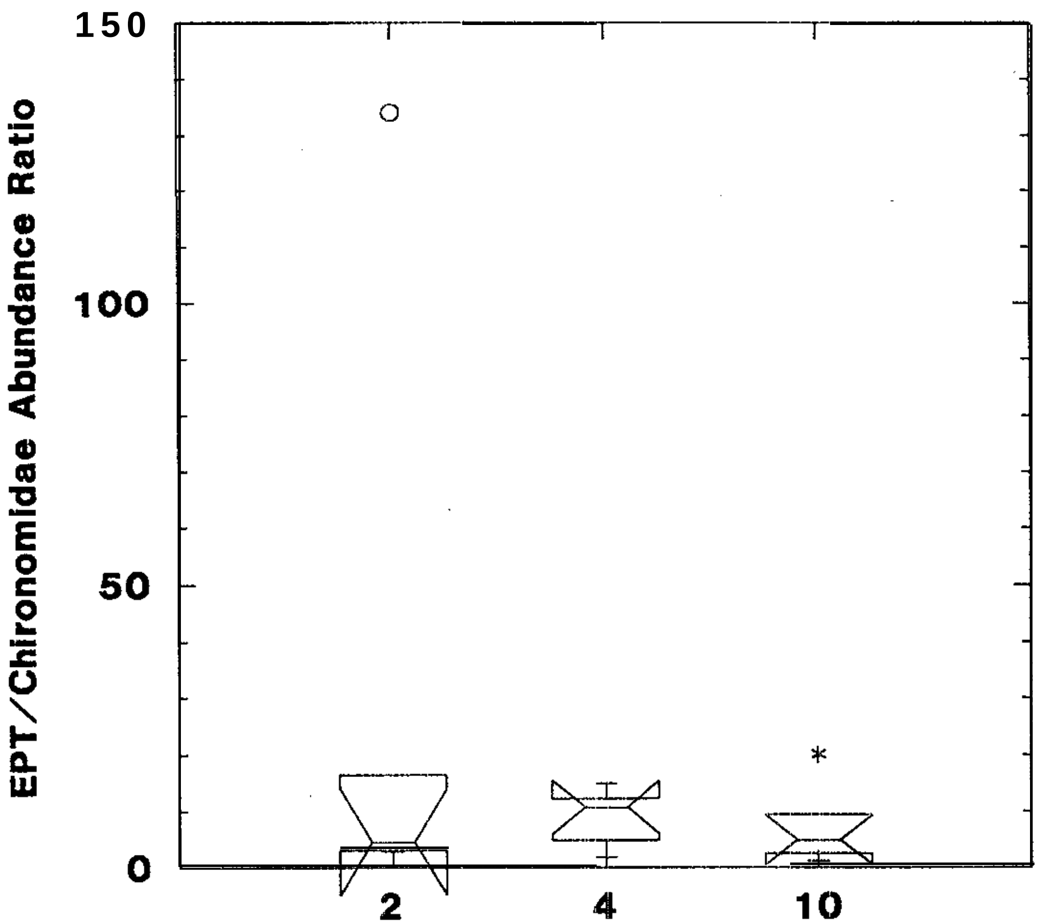
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix H27. RBP III (Summer 1991)



(Ecoregion: 2=Puget Lowland, &Cascades, 1 0=Columbia Basin)

Appendix H28. RBP III (Summer 1991)



(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix I

Rapid Bioassessment Protocol II Biometric Results
Seasonal Boxplot Figures

Box Plot Example

❑ Data outlier (greater than 3.0 times the interquartile range)

* Data outlier (within 1.5-3.0 times the interquartile range)

Maximum data point (within 1.5 times above the interquartile range)

75th Percentile

Median

Notch

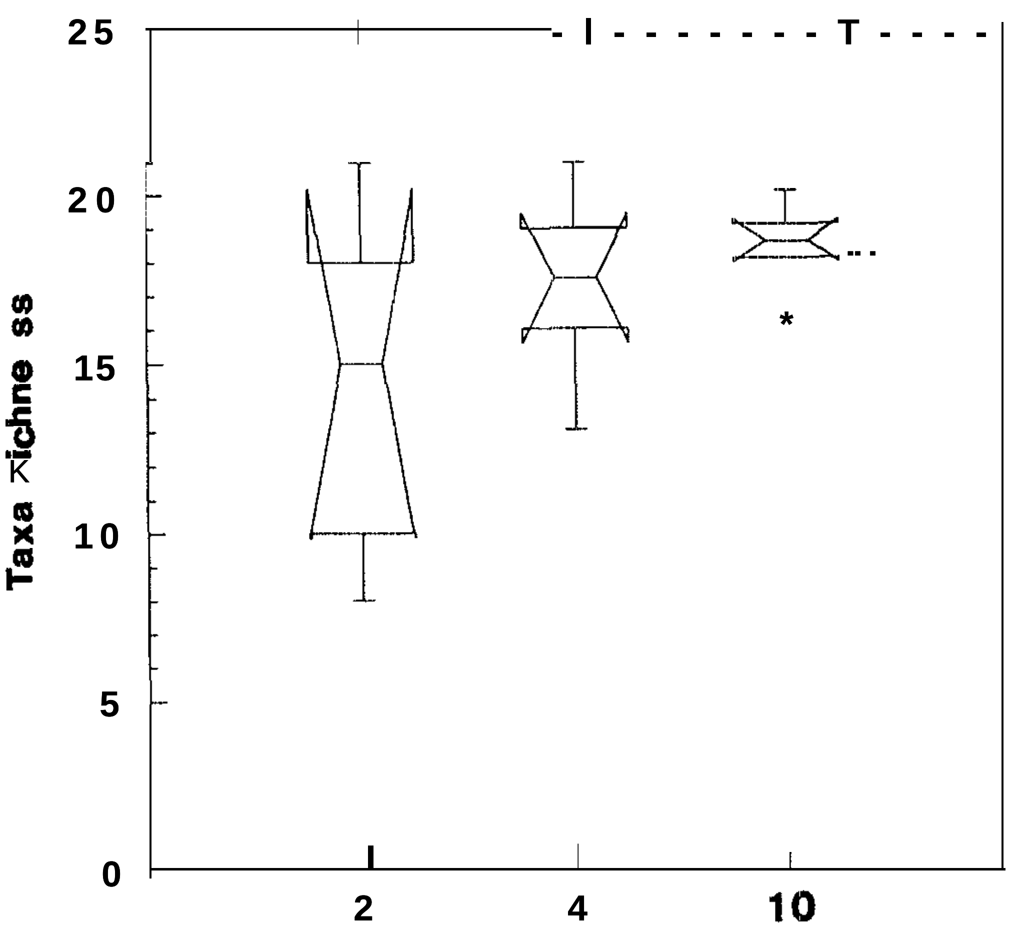
Interquartile range

25th Percentile

Minimum data point (within 1.5 times below the interquartile range)

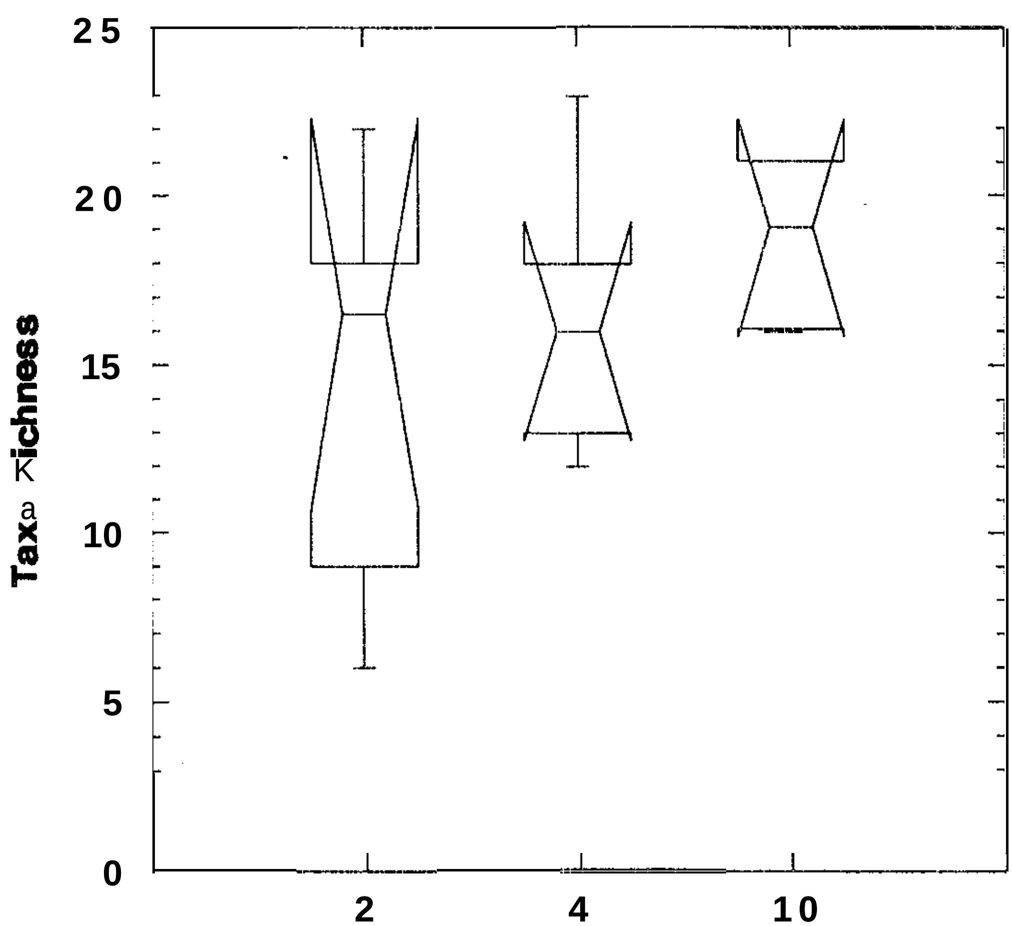
(notches in the box indicate 95% confidence intervals about the median)

Appendix I1. RBP II (Fall 1990)



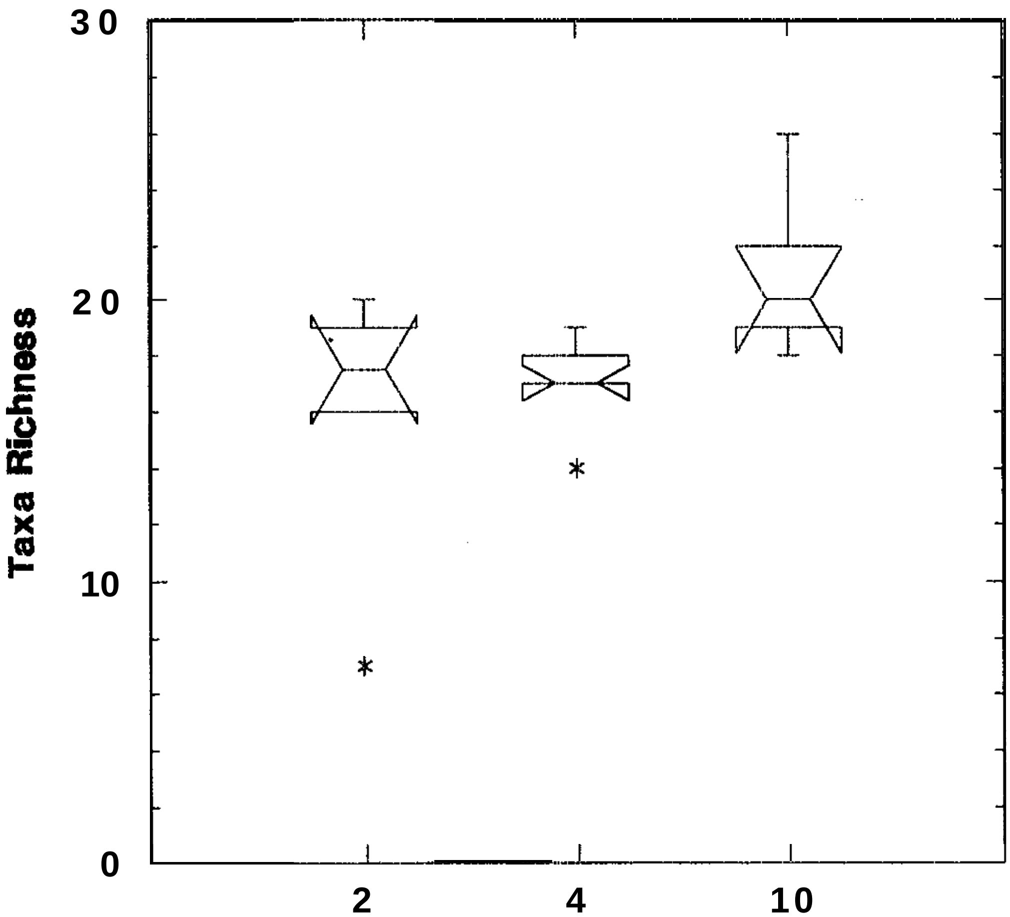
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix I2. RBP II (Winter 1991)



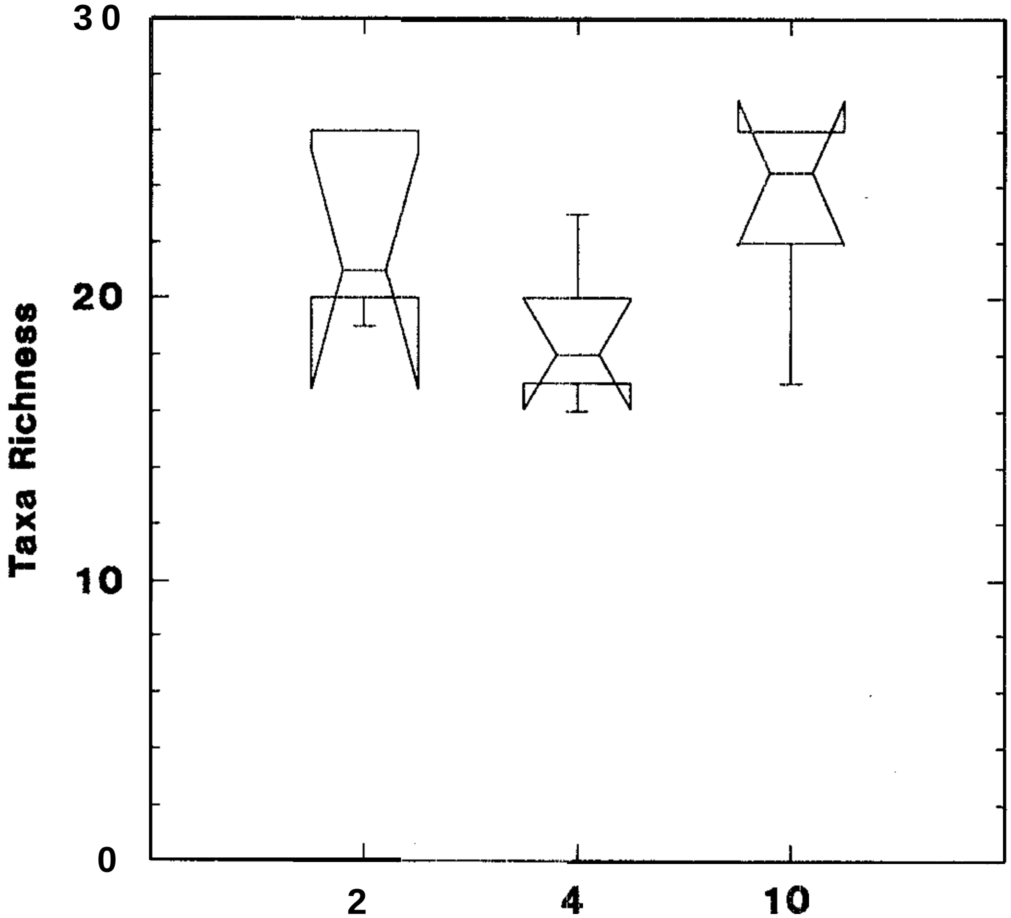
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix I3. RBP II (Spring 1991)



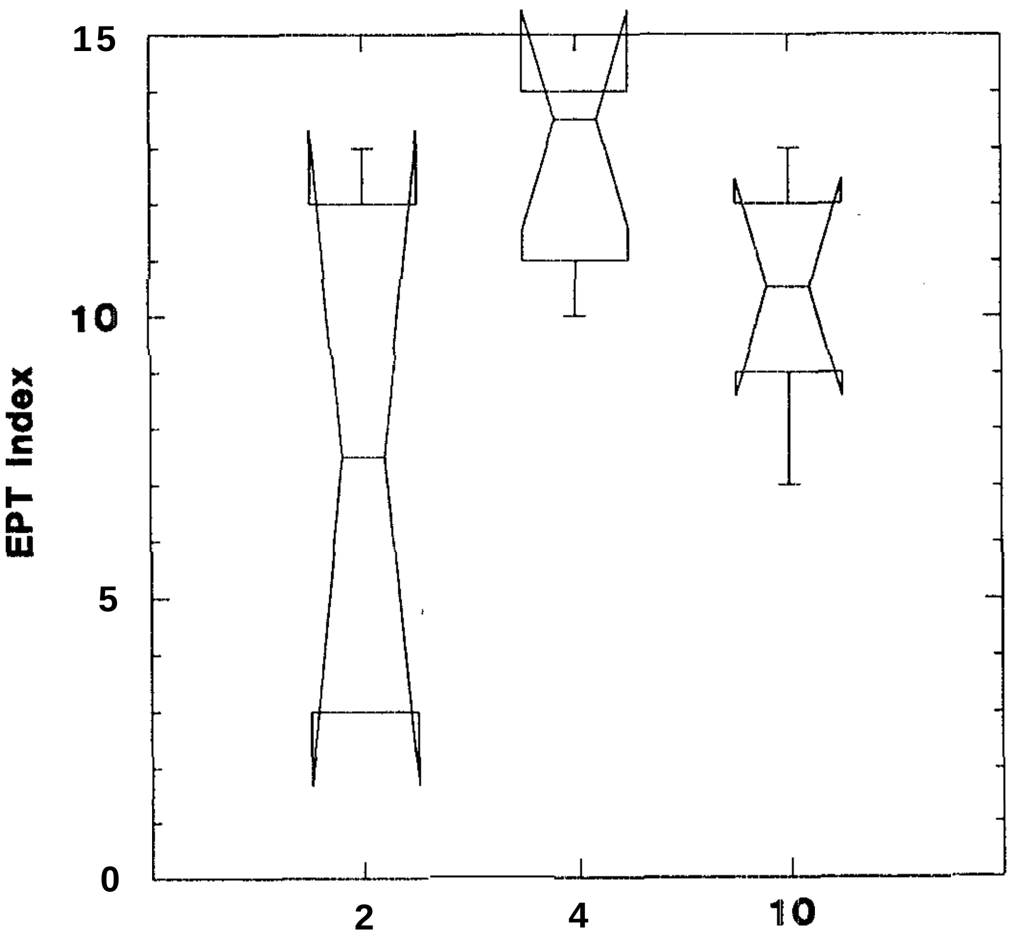
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix 14. RBP II (Summer 1991)



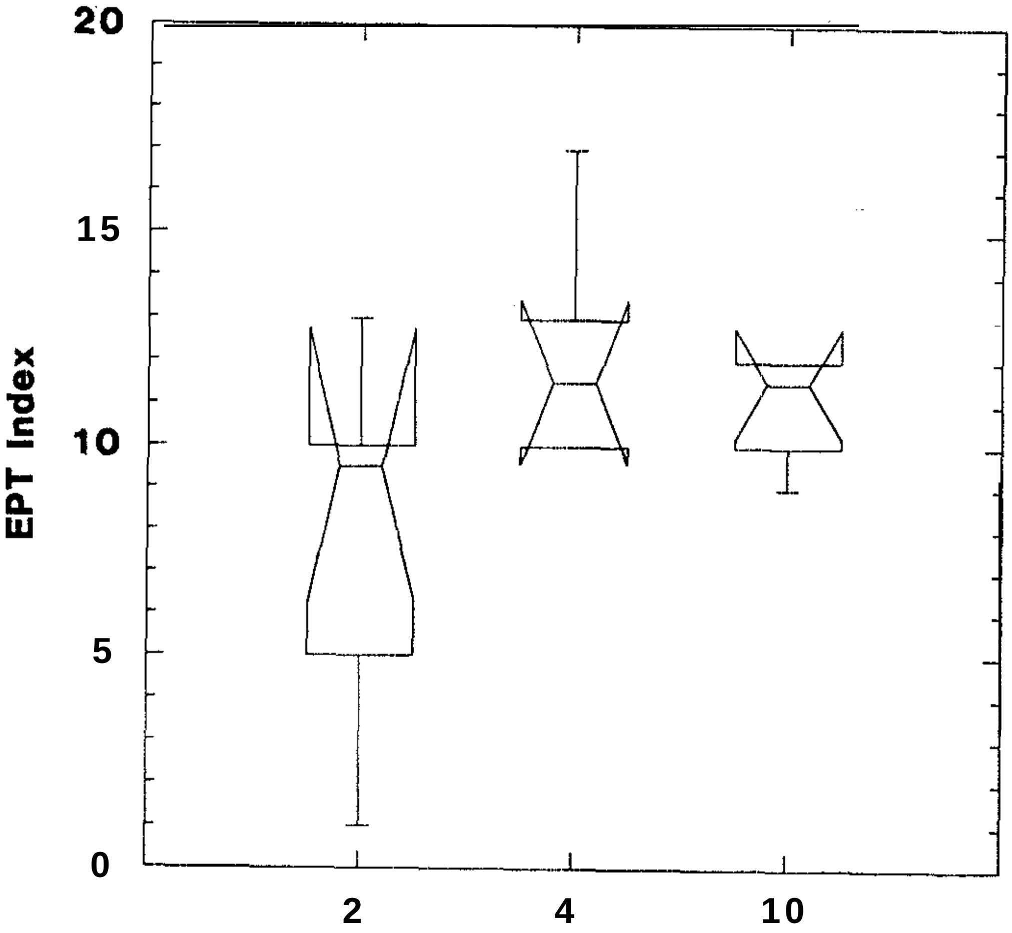
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix I5. RBP II (Fall 1990)



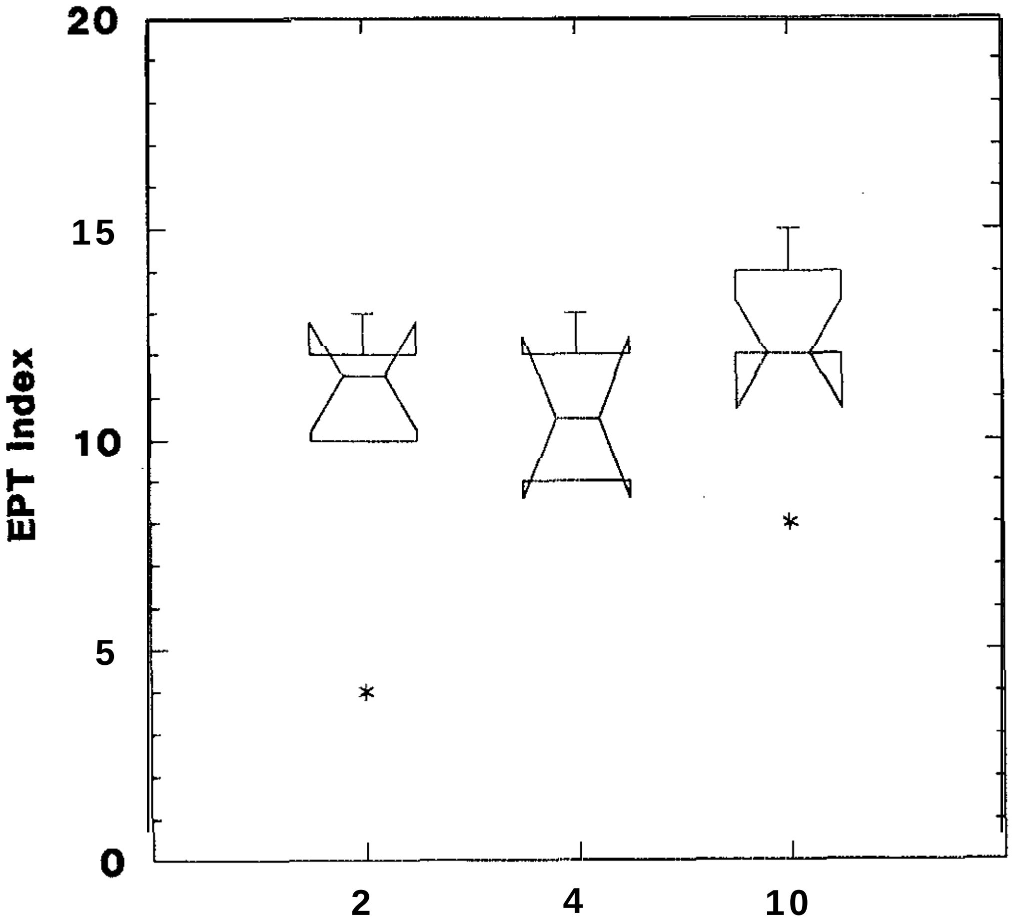
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix 16. RBP II (Winter 1991)



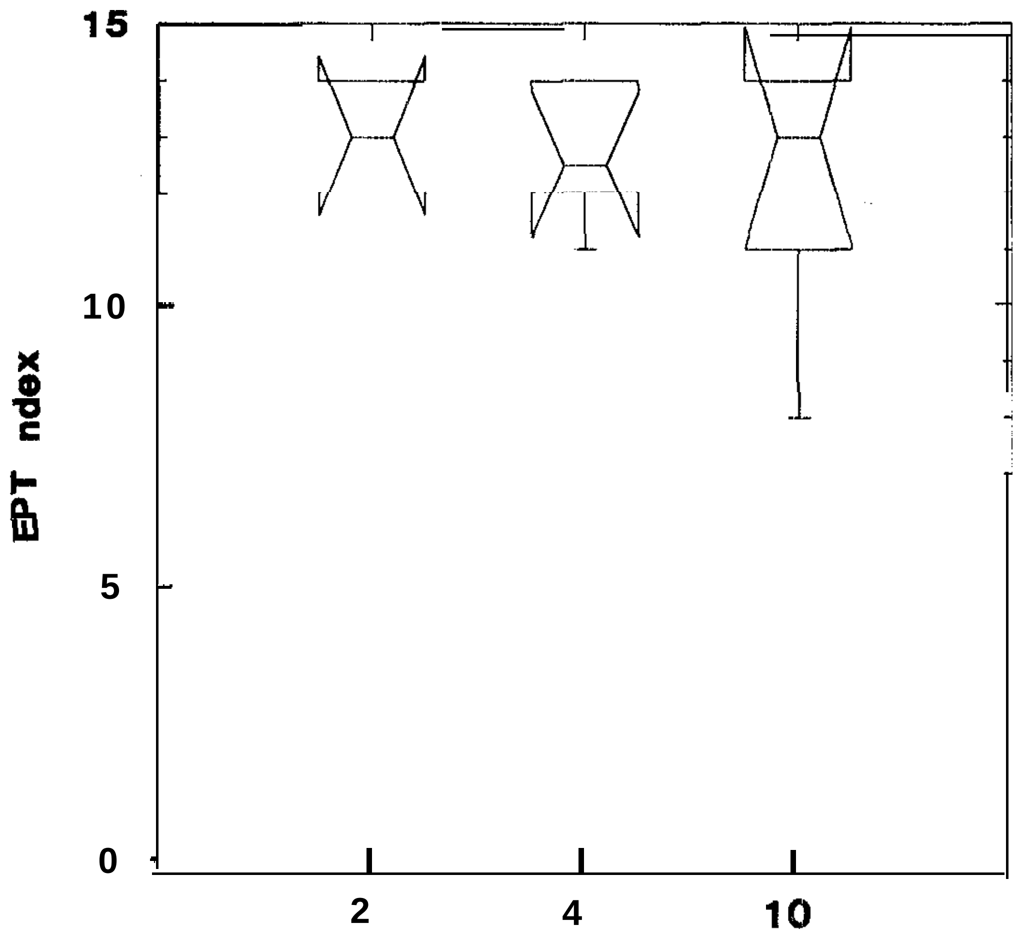
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix I7. RBP II (Spring 1991)



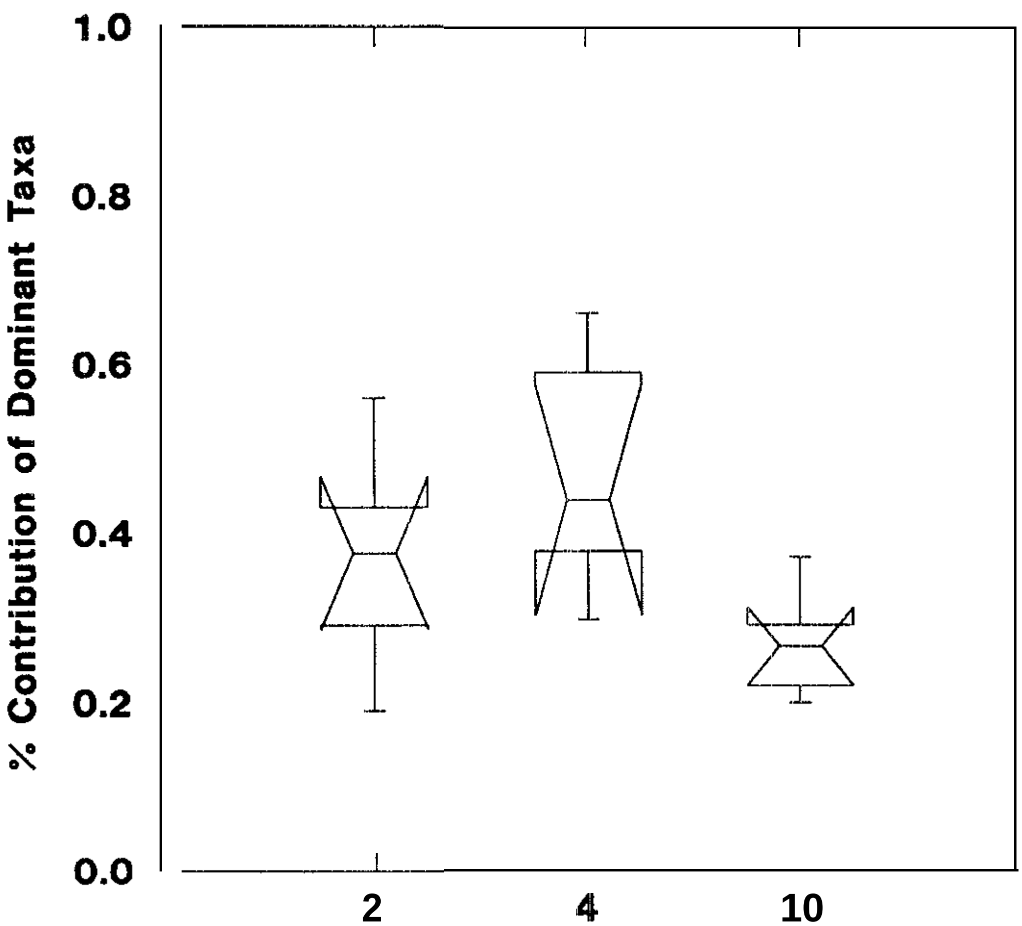
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix 18. RBP II (Summer 1991)



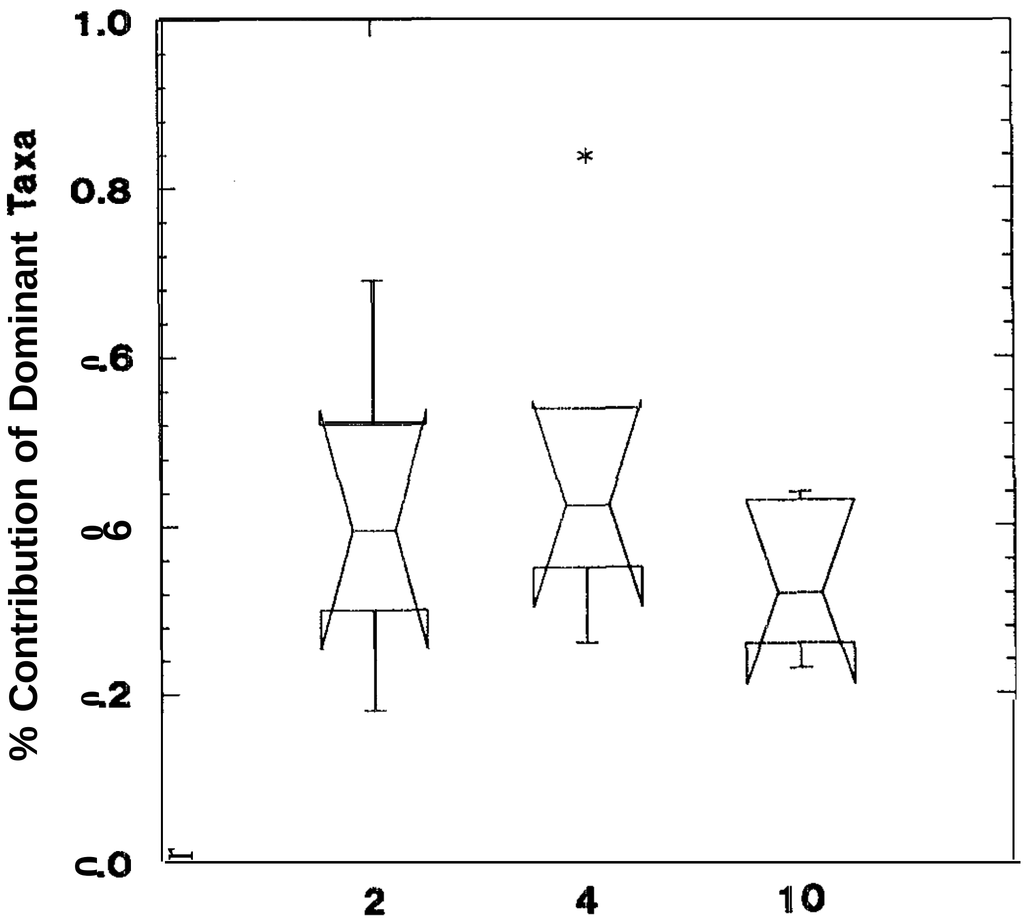
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix I9. RBP II (Fall 1990)



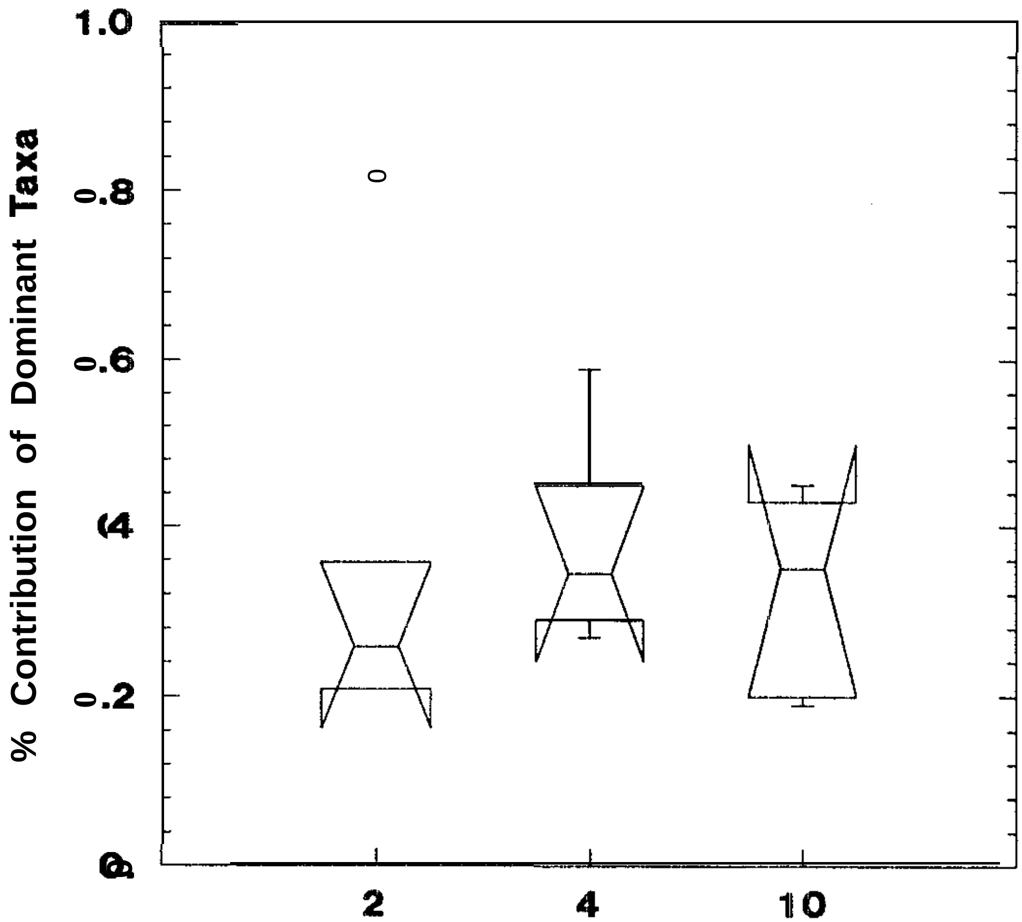
(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix O. RBP II (Winter 1991)



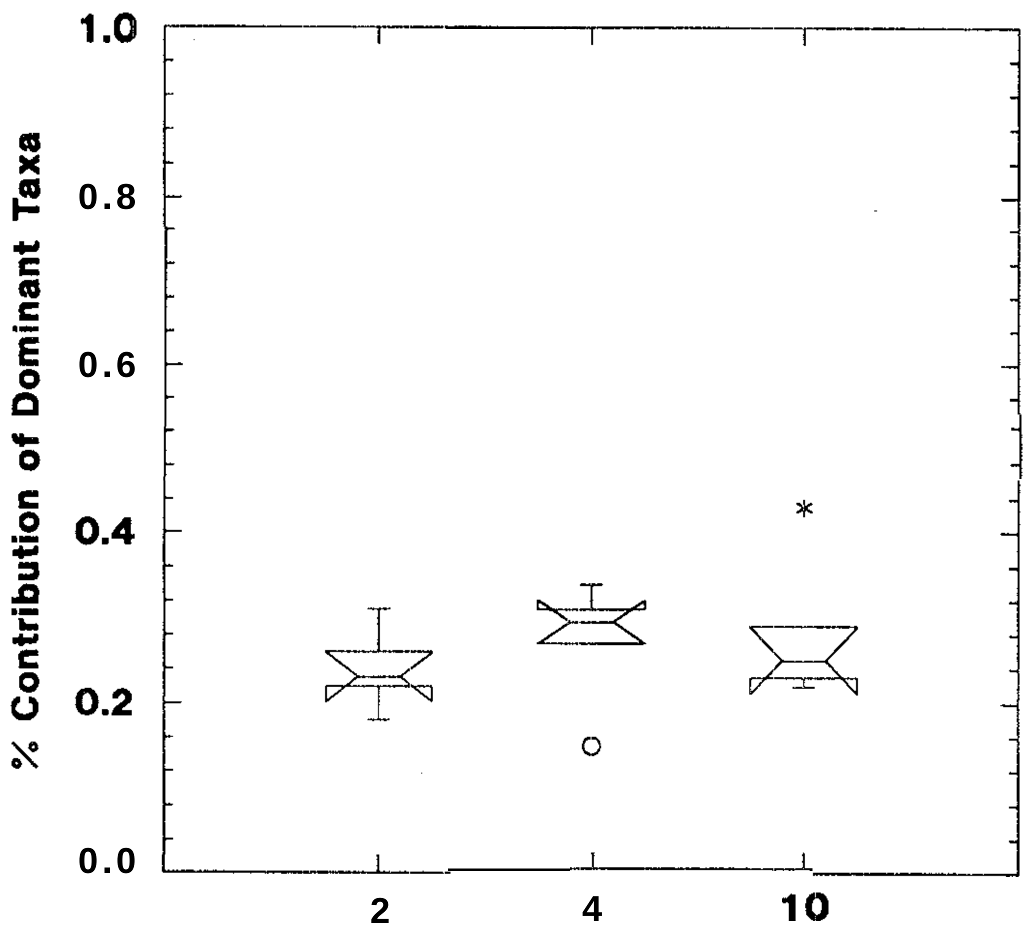
(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix I11. RBP II (Spring 1991)



(Ecoregion: 2=Puget Lowland, 4=Cascades, 10=Columbia Basin)

Appendix I1 2. RBP II (Summer 1991)

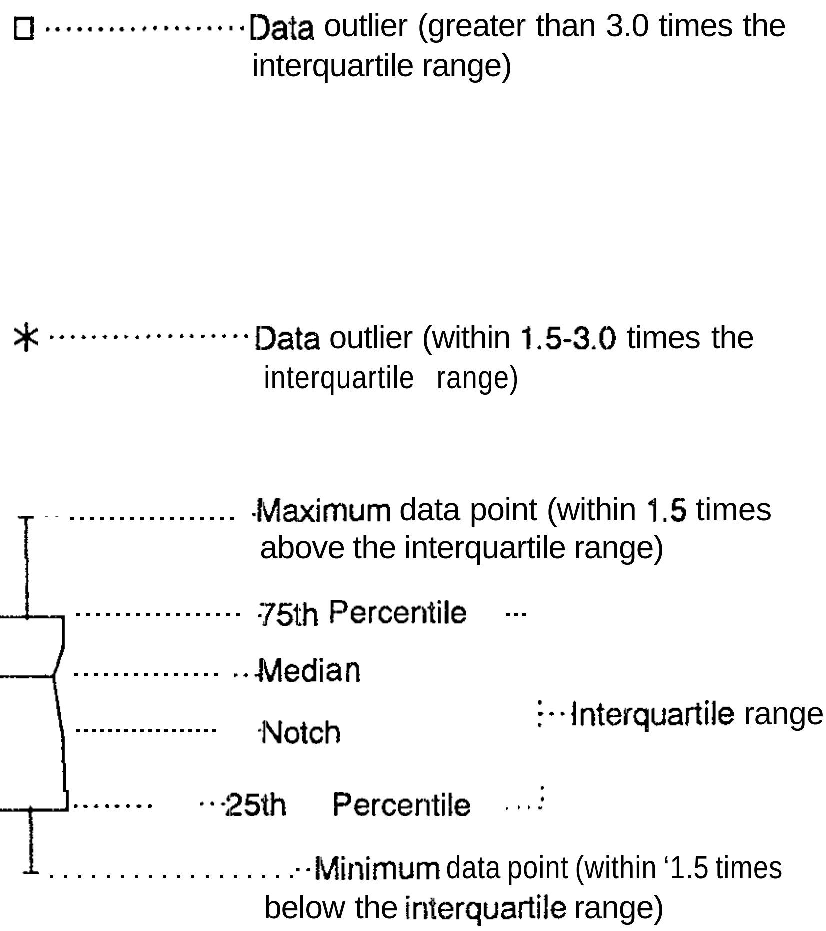


(Ecoregion: 2=Puget Lowland, 4=Cascades, 1 0=Columbia Basin)

Appendix J

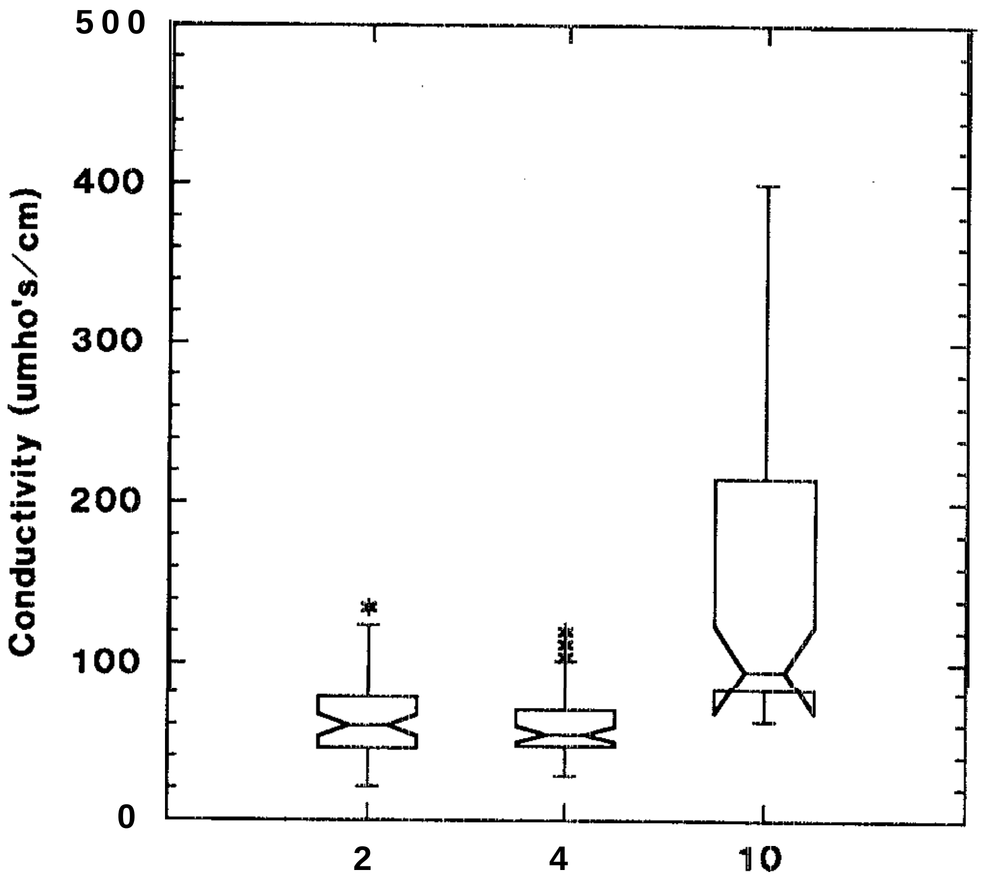
Surface Water Pararneter Ecoregion Distributions
Boxplot Figures

Box Plot Example



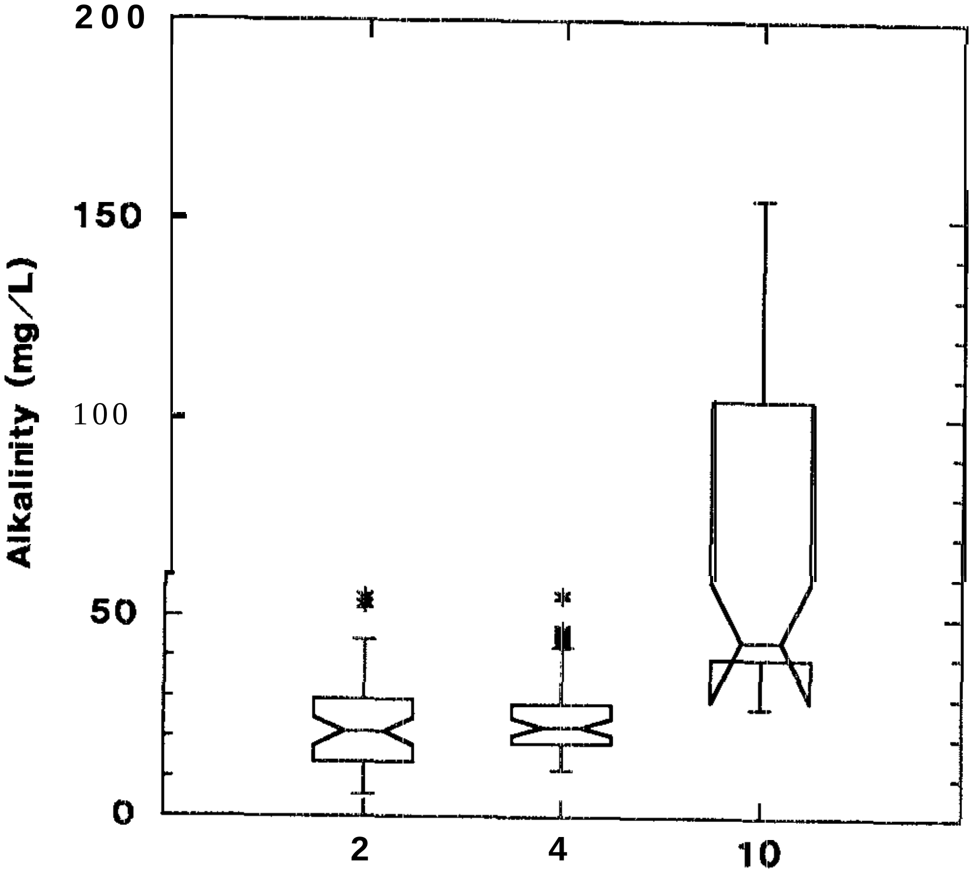
(notches in the box indicate 95% confidence intervals about the median)

Appendix J 1. Ecoregion Conductivity



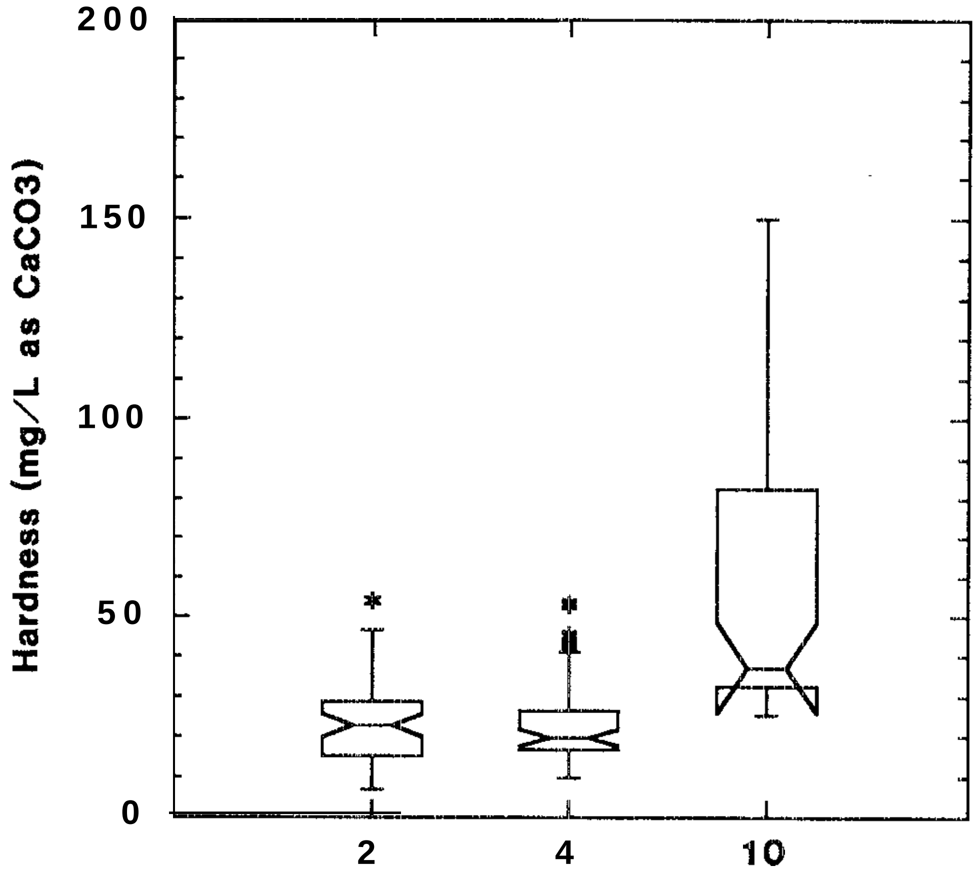
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)

Appendix J2. Ecoregion Alkalinity



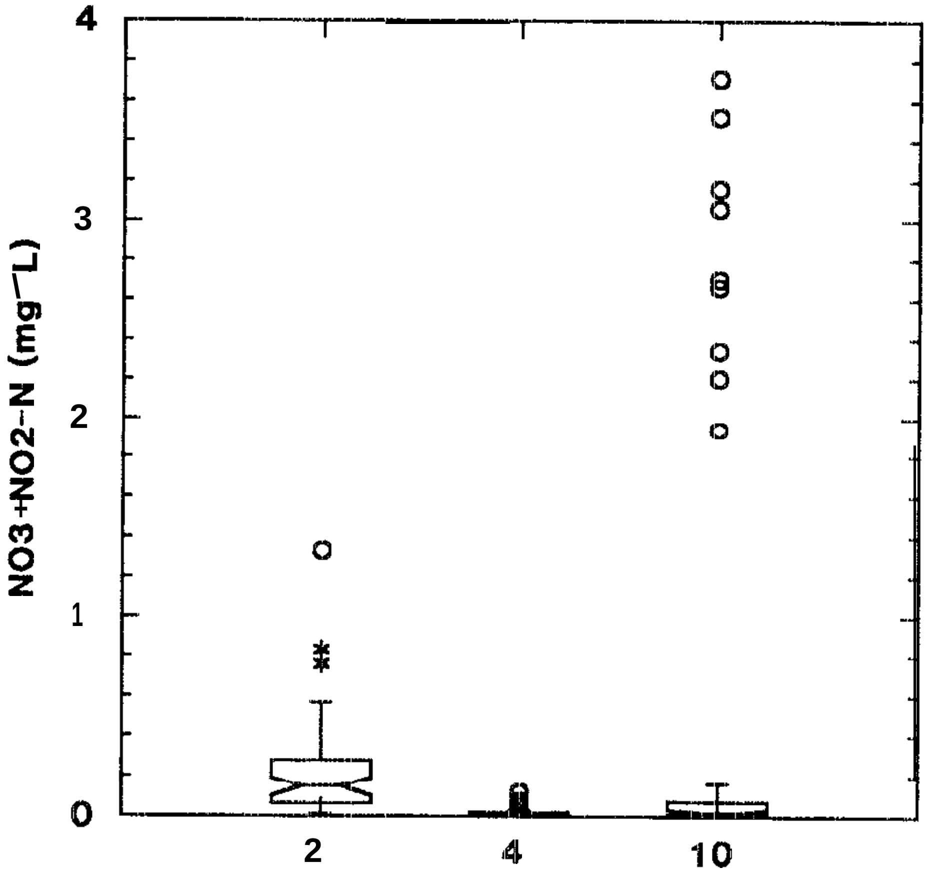
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)

Appendix J3. Ecoregion Hardness



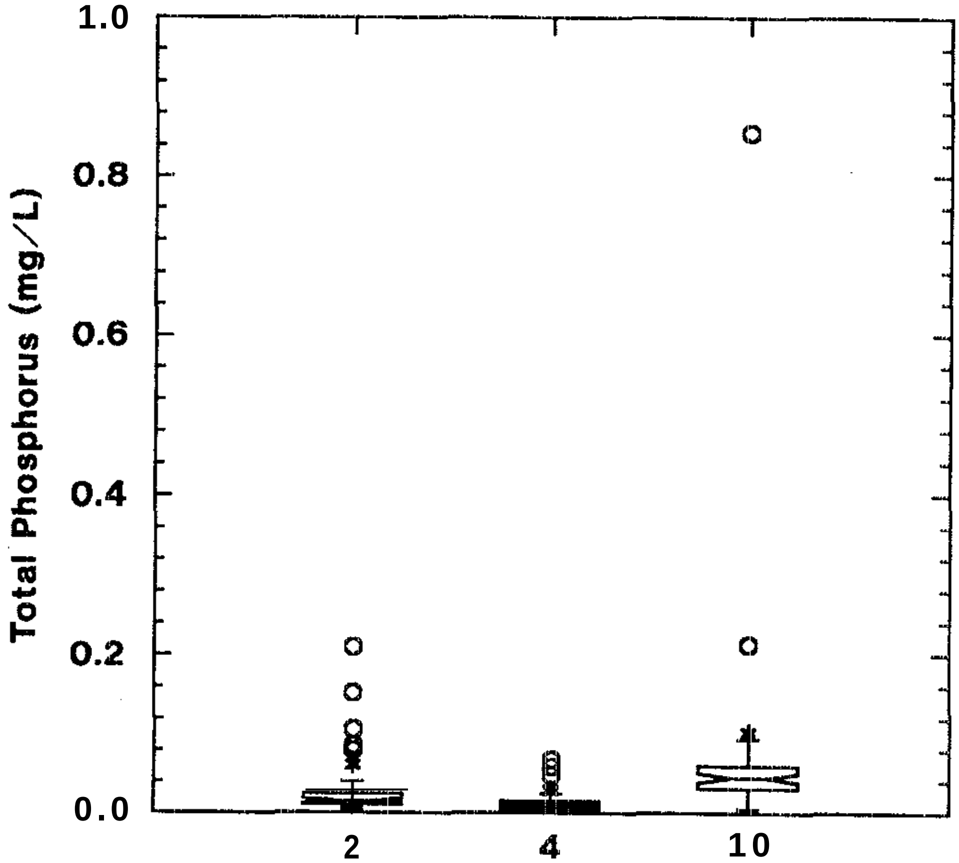
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)

Appendix J4. Ecoregion Nitrate+Nitrite-Nitrogen



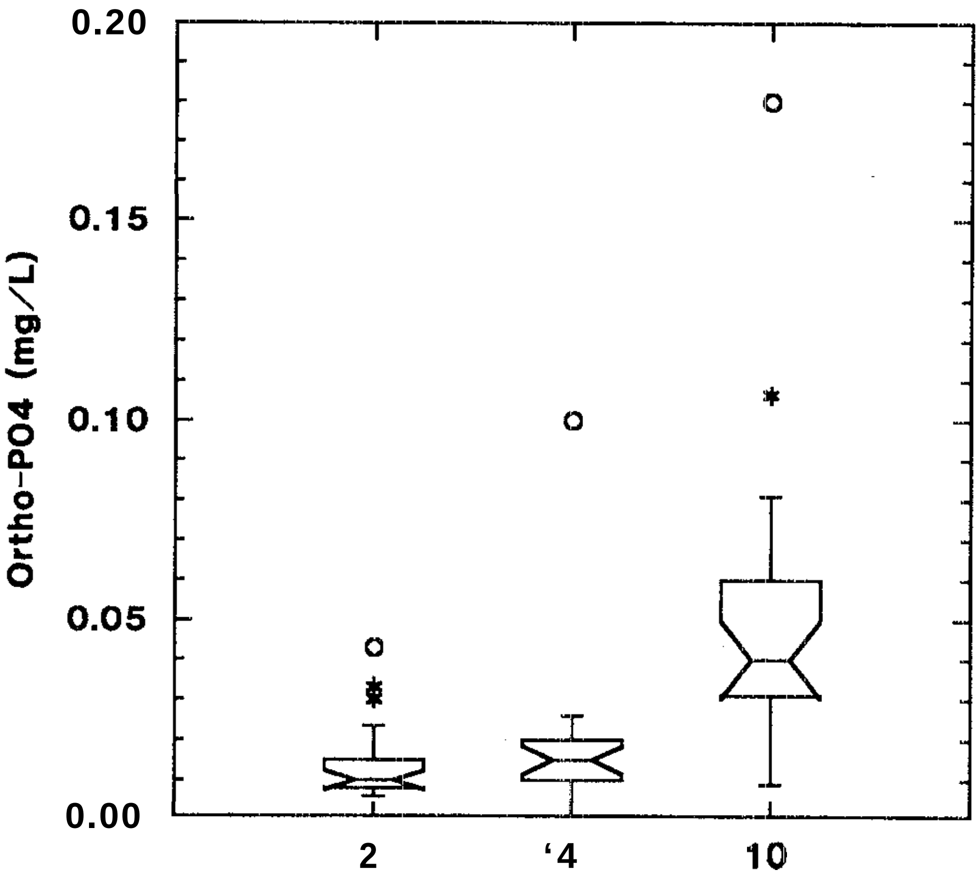
(Ecoregion: 2=Puget Lowllands, 4=Cascades, 1 0=Columbia Basin)

Appendix J5. Ecoregion Total Phosphorus



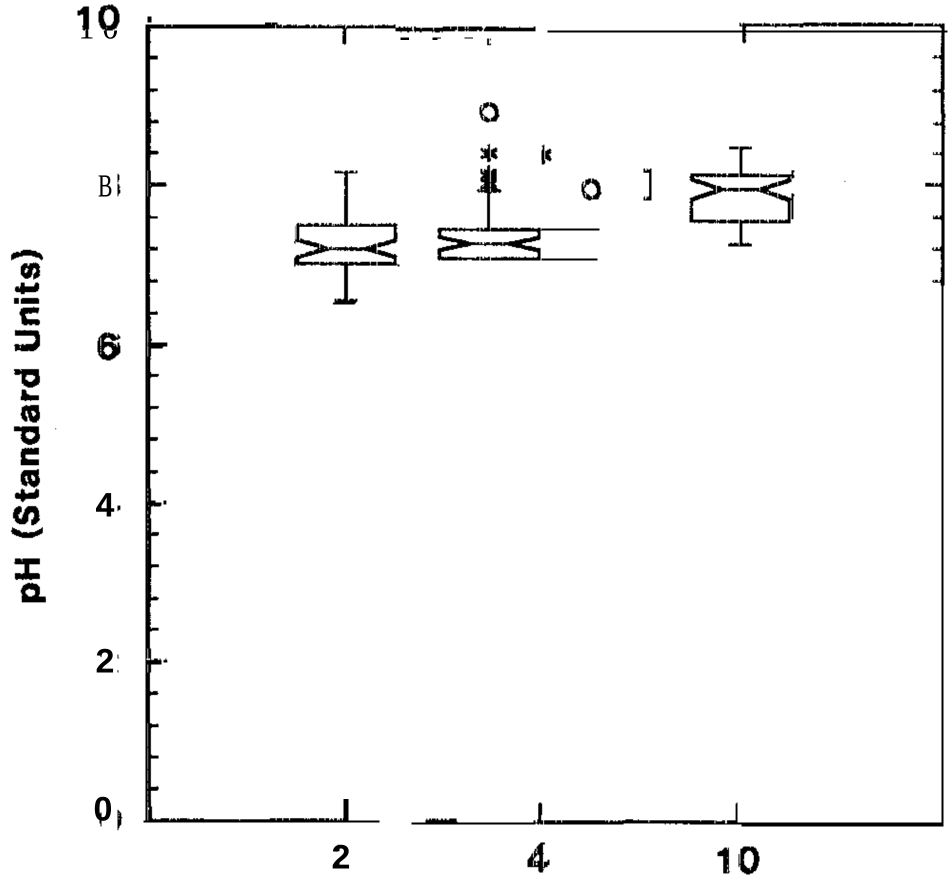
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)

Appendix J6. Ecoregion Ortho-Phosphate



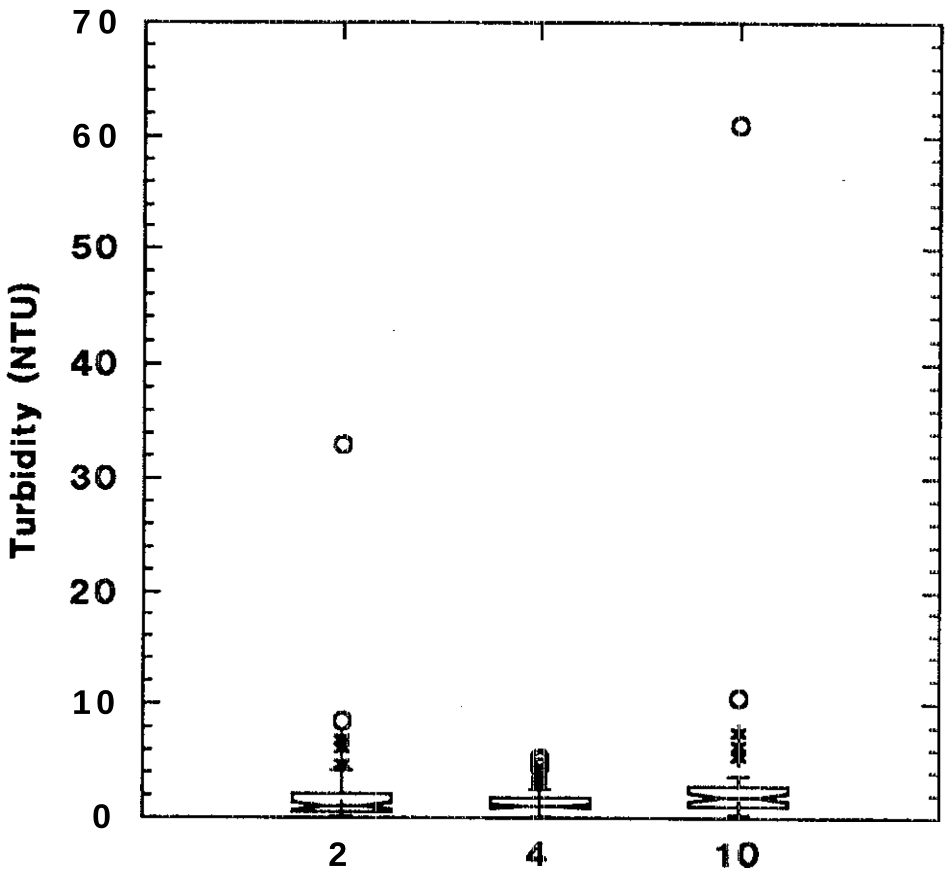
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)

Appendix J7. Ecoregion pH



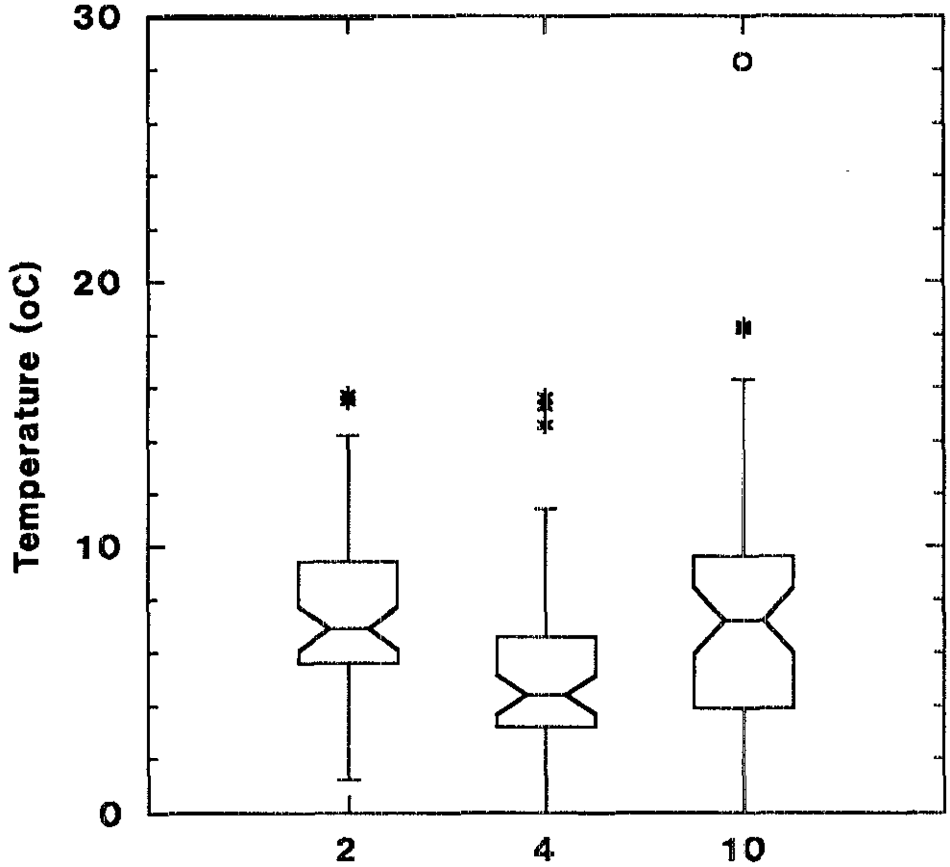
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 10=Columbia Basin)

Appendix J8. Ecoregion Turbidity



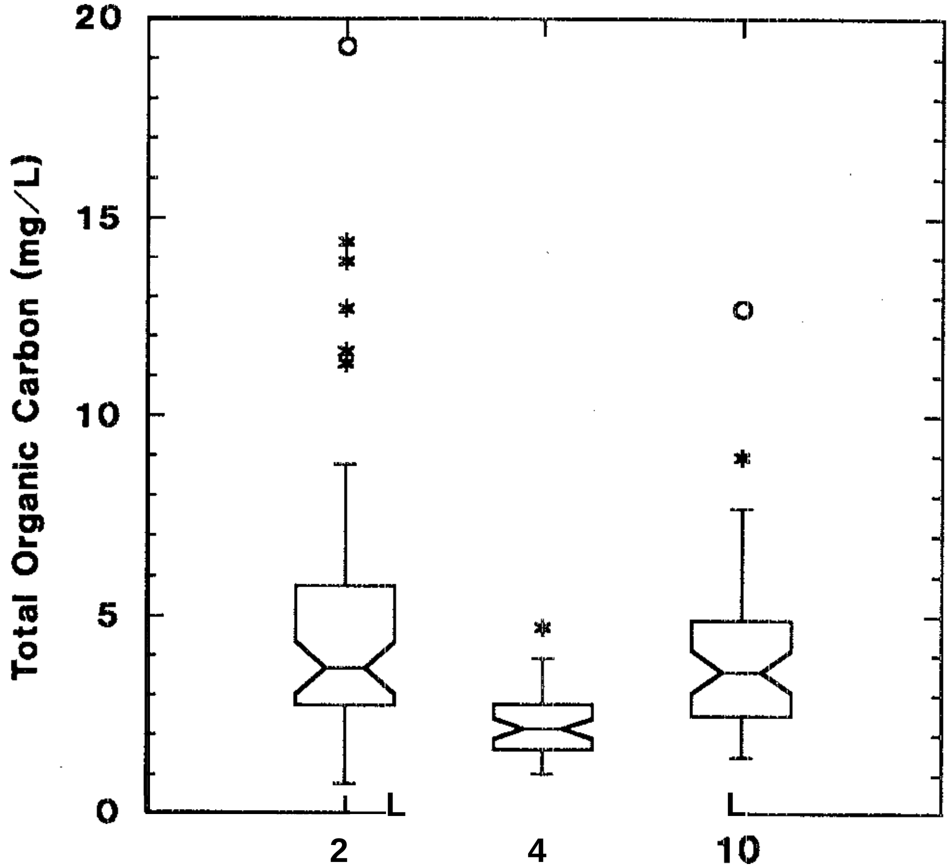
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)

Appendix J9. Ecoregion Temperature



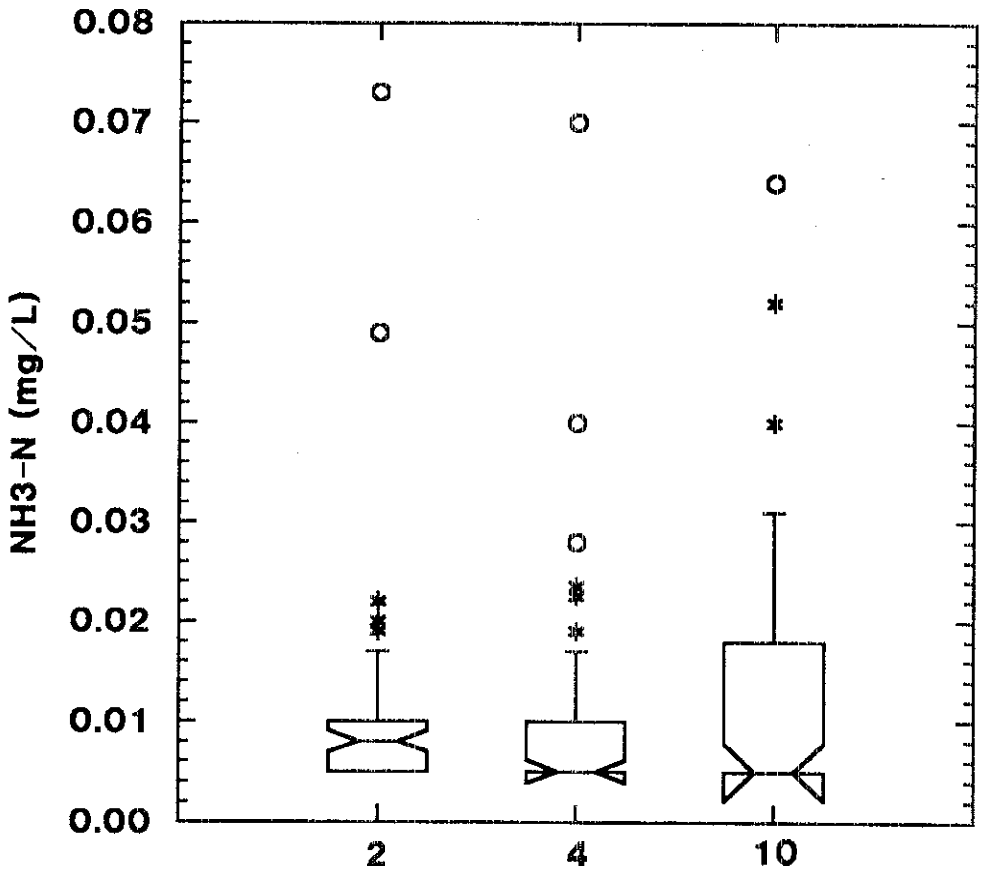
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 10=Columbia Basin)

Appendix J10. Ecoregion Total Organic Carbon



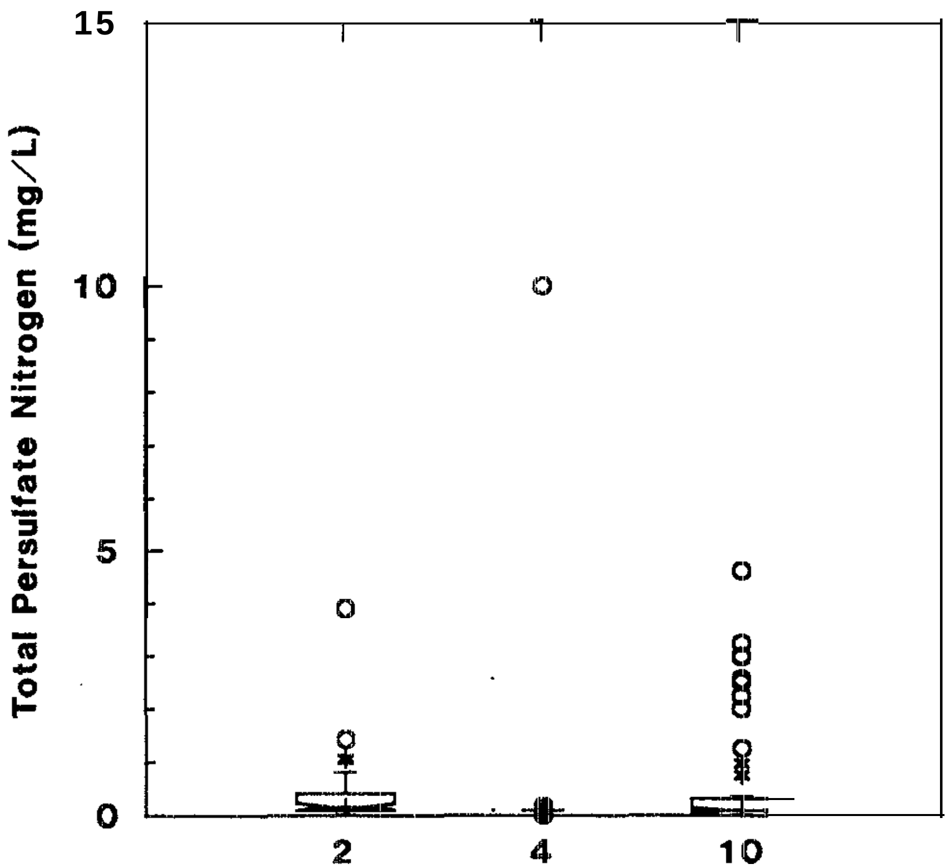
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 10=Columbia Basin)

Appendix J1 1. Ecoregion Ammonia-Nitrogen



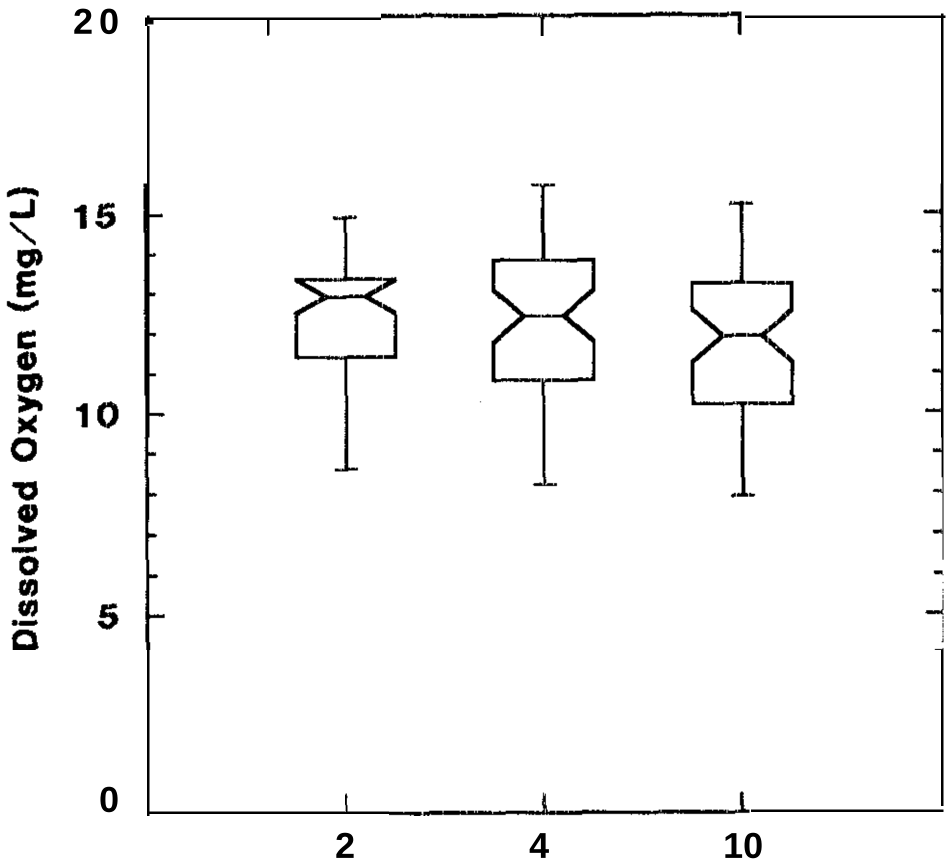
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)

Appendix J12. Ecoregion Total Persulfate Nitrogen



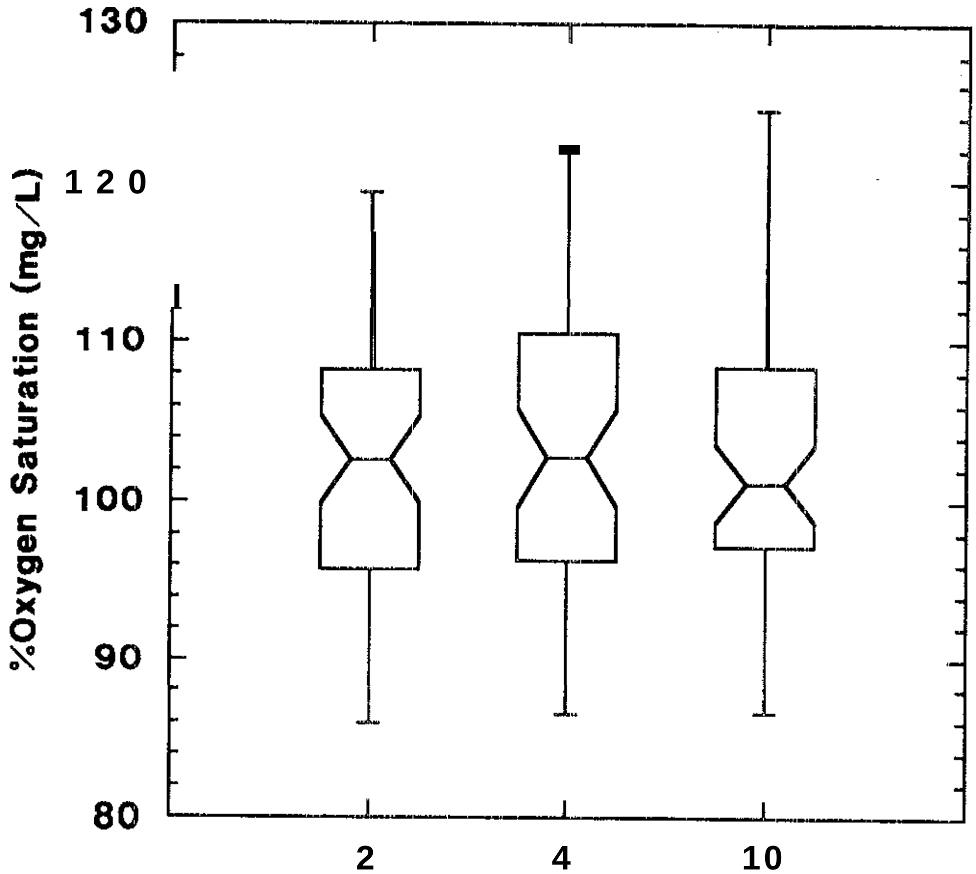
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 10=Columbia Basin)

Appendix J 13. Ecoregion Dissolved Oxygen



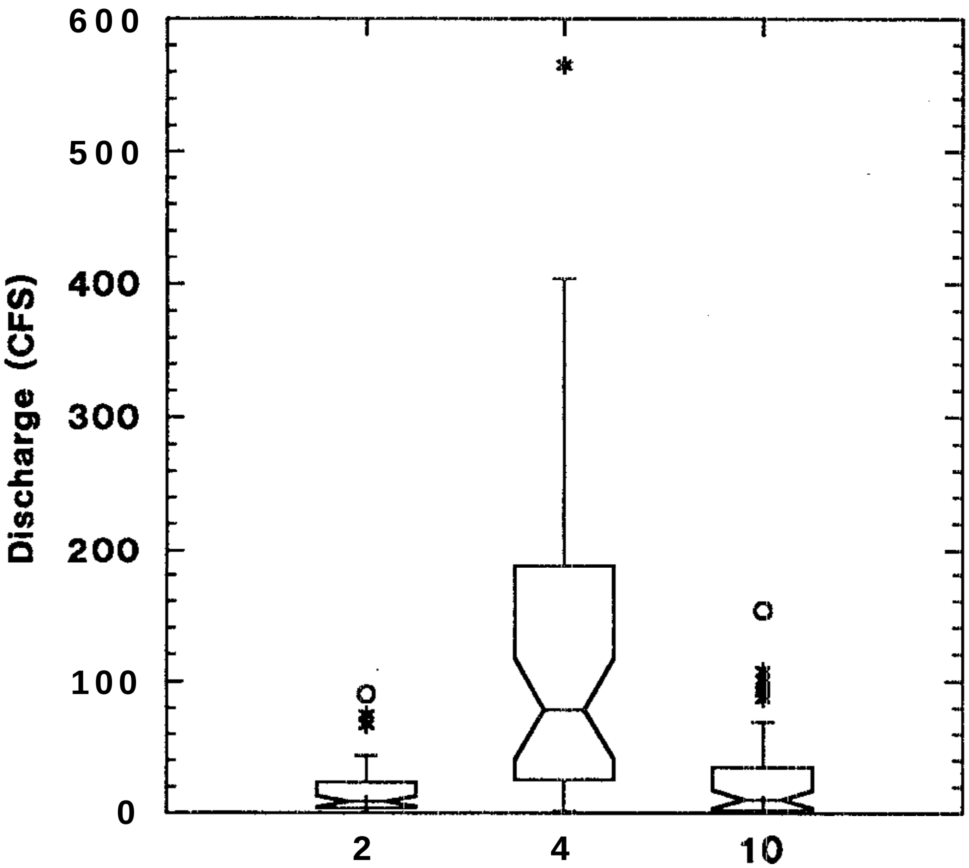
(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)

Appendix J14. Ecoregion Oxygen Saturation



(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Colum bia Basin)

Appendix J 15. Ecoregion Discharge



(Ecoregion: 2=Puget Lowlands, 4=Cascades, 1 0=Columbia Basin)